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Kenan Cetin
West Virginia Department of Environmental Protection
601 57th Street SE
Charleston, WV 25304

March 30, 2017

Subject: Union Carbide Corporation Technology Park, 2016 Groundwater Monitoring Report

Dear Mr. Cetin,

On behalf of Union Carbide Corporation (UCC), CH2M is pleased to submit the 2016 Groundwater Monitoring Report for the UCC Technology Park in South Charleston, West Virginia.

If you have any questions or comments please contact Jerome Cibrik at 304-747-7788.

Regards,

Paul Weber
CH2M HILL
Project Manager

cc: Jerome Cibrik/UCC
Erich Weissbart/USEPA
Luis Pizarro/USEPA

REPORT

2016 Groundwater Monitoring Report
Union Carbide Corporation
Technology Park
South Charleston, West Virginia

Prepared for

Union Carbide Corporation

March 2017

ch2m

Contents

Section Page

Acronyms and Abbreviations

CCR	*Current Conditions Report*
GWMP	groundwater monitoring plan
GWMR	groundwater monitoring report
MCL	maximum contaminant level
PCE	tetrachloroethylene
RCRA	Resource Conservation and Recovery Act
site	Union Carbide Corporation Technology Park, South Charleston, West Virginia
SVOC	semivolatile organic compound
UCC	Union Carbide Corporation
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WVDEP	West Virginia Department of Environmental Protection

SECTION 1

Introduction

This groundwater monitoring report (GWMR) has been prepared for the Union Carbide Corporation (UCC) Technology Park (hereafter referred to as the site) in South Charleston, West Virginia (Figure 1-1). This GWMR presents the data and findings for groundwater sampling conducted in 2016.

The U.S. Environmental Protection Agency (USEPA) issued its final decision for the facility on December 17, 2010 (USEPA 2010), and the West Virginia Department of Environmental Protection (WVDEP) incorporated the final decision into a revised Resource Conservation and Recovery Act (RCRA) permit for the site on February 2, 2012 (WVDEP 2012). Long-term groundwater monitoring in accordance with the agency-approved groundwater monitoring plan (GWMP) (CH2M 2009) is a component of the final decision for the site.

Groundwater monitoring at the site was conducted in accordance with the GWMP to meet the following objectives:

- Monitor water levels to evaluate potential changes in groundwater flow directions;
- Monitor constituent concentrations to evaluate trends;
- Monitor constituent concentrations to evaluate groundwater conditions in Ward Hollow;
- Monitor constituent concentrations to evaluate groundwater conditions in the Greenhouse Area;
- Evaluate the integrity of the monitoring wells being used in this GWMR by conducting inspections; and;
- Monitor the effectiveness of corrective measures.

Additional groundwater monitoring, beyond that which is required in the GWMP, was conducted for Ward Hollow in 2016 to further evaluate observed increases in groundwater concentrations in some of the Ward Hollow monitoring wells. The additional monitoring consisted of increased frequency of groundwater monitoring (conducted quarterly). Results of the additional monitoring completed in 2016 are summarized in this report.

SECTION 2

Background

The site covers 574 acres in the city of South Charleston, West Virginia, including 267 acres that have been sold or donated to other parties. UCC has retained the remaining 307 acres, which consist largely of the landfills and areas surrounding the landfills. Topography at the site is generally steep, with flatter, developed areas at the top of hills. Other portions of the site terrain have been altered by the construction of the Lower Ward Landfill, Ward A Landfill, and Ward B Landfill (Figure 1-1). The elevation of the site ranges from 580 to 1,090 feet above mean sea level.

The areas of groundwater contamination addressed in this GWMR are Ward Hollow and the Greenhouse Area, both of which are discussed in detail in the *Current Conditions Report* (CCR; CH2M 2008) and are summarized below.

2.1 Ward Hollow

The Lower Ward Landfill, Ward A Landfill, Ward B Landfill, and a former brine well north of Lower Ward Landfill have contaminated the groundwater in Ward Hollow. Contaminated groundwater has migrated from these sources to the underlying weathered bedrock and then downgradient into Ward Hollow. The most prominent constituents present within this plume are 1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium.

2.2 Greenhouse Area

The source of groundwater contamination in the Greenhouse Area is unknown. Two monitoring wells (WVU-MW04 and MW-104A) screened in the Mahoning Sandstone have exhibited detectable concentrations of volatile organic compounds (VOCs).

SECTION 3

Groundwater Monitoring

The GWMP requires groundwater samples and water levels to be collected every 9 months at the locations shown on Figure 3-1 (CH2M 2009). Per the GWMP, the 2016 sampling was scheduled to occur in March and December 2016, but the March event was delayed until May 2016 due to the ongoing dye tracer test at the Ward Hollow Area. For the Greenhouse Area, groundwater samples and water levels were collected in May and December 2016. For Ward Hollow, groundwater sampling and water level measurements were collected in May, September, and December 2016.

This section summarizes how the sampling was conducted and observations made during sampling activities.

3.1 Water Level Measurements

Table 3-1 lists water levels and groundwater elevations measured in May, September, and December 2016. Details of well construction are listed on Table 3-2. During each event, measurements were collected over a 12-hour period using a handheld water level meter. Water levels were collected from monitoring wells, piezometers, and staff gauges during each event. Groundwater elevation data from the monitoring wells and piezometers were used to analyze the potentiometric surface and groundwater flow patterns.

3.2 Groundwater Sampling

Groundwater samples were collected in May, September, and December 2016. Table 3-3 lists the analytical suites and sample identifiers for the monitoring wells sampled. Sampling was conducted using low-flow sampling protocols (USEPA 2002) or volumetric purging if low-flow was not possible based on historical data for a given monitoring well.

Two monitoring wells in the Greenhouse Area were sampled during the May and December 2016 sampling events in accordance with the GWMP. For Ward Hollow, six monitoring wells in the GWMP plus MW-21, MW-34, and MW-35 were sampled in May, September, and December 2016. Monitoring well BW-02, although included in the GWMP, is not owned by UCC. BW-02 was sampled in May and September 2016; however, the well could not be sampled in December 2016 because the well was abandoned. Monitoring locations for the Ward Hollow groundwater plume consists of downgradient wells, sentinel wells, and impacted wells (Table 3-3). Downgradient wells are the wells that are furthest downgradient and typically have constituent concentrations that are below screening levels. The sentinel wells are the most downgradient wells that consistently have constituent concentrations above screening levels. Impacted wells are wells at the landfills or immediately downgradient of the landfills.

The groundwater samples collected from Ward Hollow were analyzed for VOCs, semivolatile organic compounds (SVOCs), and dissolved metals. The two monitoring wells sampled in the Greenhouse Area (WVU-MW04 and MW-104A) historically have contained concentrations of VOCs above screening levels; therefore, the samples from these wells were only analyzed for VOCs.

3.3 Leachate Collection System Sampling

Grab samples of the leachate in the Lower Ward Leachate Collection System were collected in May, September, and December 2016 to better understand concentrations leaching from the landfill. The leachate samples were analyzed for VOCs, SVOCs, and dissolved metals.

SECTION 4

Results

4.1 Groundwater Flow Patterns

Groundwater level data, along with the top-of-casing elevations, were used to determine groundwater elevations at the facility and prepare a potentiometric surface map. Table 3-1 presents the water level measurements and calculated elevations for each monitoring well, piezometer, and staff gauge. Figures 4-1 and 4-2 show the December 2016 potentiometric surface maps for Ward Hollow and the Greenhouse Area, respectively.

4.1.1 Ward Hollow

Consistent with the topography of Ward Hollow, groundwater flow is to the northwest, toward the Kanawha River. Figure 4-1 shows the potentiometric surface of the Upper Freeport Formation within Ward Hollow for data collected on December 1, 2016. Water levels observed in May and September 2016 were consistent with the groundwater flow patterns observed in December 2016 and previous years; therefore, only the December 2016 results were mapped.

4.1.2 Greenhouse Area

Figure 4-2 shows the potentiometric surface of the Mahoning Sandstone within the Greenhouse Area for data collected on December 1, 2016. Groundwater in this area flows to the north, toward the Kanawha River. Water levels observed for the Greenhouse Area in 2016 were consistent with the groundwater flow patterns observed in previous years.

4.2 Constituent Concentration Evaluation

Analytical results for detected constituents in groundwater and leachate are presented in Tables 4-1 and 4-2 for Ward Hollow and the Greenhouse Area, respectively. The analytical results were compared to USEPA maximum contaminant levels (MCLs) (USEPA 2009), or if an MCL was not available for a detected constituent, the adjusted USEPA tap water regional screening level (USEPA 2016) was used. These comparisons are provided in Tables 4-1 and 4-2. Appendix A contains the laboratory data packages and the data quality evaluation memorandum.

4.2.1 Ward Hollow

A comparison of the analytical results to screening levels (Table 4-1) shows that 1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium remain the most prominent constituents present within this groundwater plume. Figures 4-3 through 4-6 show the lateral extent of 1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium in Ward Hollow. 1,4-Dioxane and barium have the largest lateral extent in groundwater, which is observed vertically within the aquifer as well. Figures 4-7 and 4-8 show the vertical extent of 1,4-dioxane and bis(2-chloroisopropyl)ether, respectively, in Ward Hollow. 1,4-Dioxane is observed throughout the aquifer whereas bis(2-chloroisopropyl)ether is observed primarily within the shallow aquifer in the monitoring wells closest to the landfill but is also observed deeper within the aquifer in downgradient monitoring wells.

Analytical data collected from all of the 2016 sampling events for Ward Hollow show that exceedances for benzene and bis(2-chloroisopropyl)ether remain delineated downgradient by MW-31, MW-32, and BW-02. However, 1,4-dioxane and barium were detected at a concentrations above the screening level in downgradient monitoring well MW-31. Exceedances of the 1,4-dioxane screening level in downgradient monitoring well MW-31 have been observed in previous sampling events and the

observed concentrations for 2016 are within historical ranges; however, the exceedance of barium in MW-31 for the December 2016 sampling event is the first occurrence. The source of the barium contamination in Ward Hollow does not appear to be related to the landfills because concentrations downgradient of the landfills are an order of magnitude higher than what is observed in the leachate collection system. The source of barium contamination is assumed to be the former brine well next to MW-01 (Figure 1-1).

Other constituents that exceeded screening criteria were arsenic, cadmium, and bis(2-chloroethyl)ether. Arsenic exceeded the screening level in five monitoring wells (BW-02, MW-23, MW-26, MW-28, and MW-34). Arsenic concentrations observed in groundwater throughout Ward Hollow appear to be representative of naturally occurring levels. The arsenic concentrations in Ward Hollow are similar to those observed previously in monitoring wells (MW-29, MW-30, and BW-02) outside the boundary of the groundwater plume that are screened in the Upper Freeport Formation. In addition, detections of arsenic in Ward Hollow are highly variable (e.g., detected above the screening level for most wells in September 2015 but non-detect for most wells in December 2015 and May 2016), which is different than what is observed for other constituents in the groundwater plume. Cadmium slightly exceeded the screening level in four monitoring wells (MW-26, MW-28, MW-34, and MW-35). Similarly, bis(2-chloroethyl)ether exceeded the screening criteria for the May 2016 samples from MW-26 and MW-35; however, bis(2-chloroethyl)ether was not detected in any of the monitoring wells during the September and December 2016 events.

The groundwater plume stability was evaluated based on monotonic trend analysis of groundwater data using the Mann-Kendall non-parametric statistical test (Gilbert 1987) to investigate whether constituent concentrations in groundwater are increasing, decreasing, or stable. Mann-Kendall statistical tests were performed for four key constituents (1,4-dioxane, bis[2-chloroisopropyl]ether, benzene, and barium) using groundwater analytical data collected at seven monitoring wells. The Mann-Kendall statistical tests were performed for two different data sets; one for all data and the other for data from 2011 through 2016. The results of Mann-Kendall statistical tests along with graphs showing concentrations over time[1] are provided in Appendix B. The trends were stable or decreasing except for the following:

- 1,4-Dioxane: one monitoring well (MW-31) exhibited an increasing trend. Visual observation of data indicate increasing trends from 2004 through 2006 and from 2013 through 2016. Although data since 2013 show an increasing trend, concentrations are still within historical range and below the highest concentration of 16.4 parts per billion detected in late 2006.
- Bis(2-chloroisopropyl)ether: two monitoring wells (MW-01 and MW-23) exhibited increasing trends for all data but exhibited a stable trend for data from 2011 to 2016.
- Benzene: four monitoring wells (MW-01, MW-23, MW-26, and MW-28) exhibited increasing trends for all data but exhibited a stable trend for data from 2011 to 2016.
- Barium: four monitoring wells (MW-23, MW-28, MW-31, and MW-32) exhibited increasing trends for all data; however, only three monitoring wells (MW-23, MW-31, and BW-02) exhibited increasing trends for data from 2011 to 2016.

4.2.2 Leachate Collection System

Analytical data collected from the leachate in 2016 show that the most prominent constituents (1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium) present within the groundwater plume are also observed in the leachate at concentrations above screening levels. In addition,

[1] Monitoring wells with three or more consecutive non-detect results were not plotted.

2,4-dimethylphenol, 2-methylnapthalene, naphthalene, 1,2-dichloroethane, 1,2-dichloropropane, and arsenic were detected above their respective screening levels (Table 4-1).

Mann-Kendall statistical tests were performed for 1,4-dioxane, bis(2-chloroisopropyl)ether, benzene, and barium using analytical data for the leachate. The Mann-Kendall statistical tests were performed for two different data sets; one for all data and the other for data from 2011 to 2016. The results of Mann-Kendall statistical tests along with graphs showing concentrations over time are provided in Appendix B. Trends based on all data are stable for 1,4-dioxane, bis(2-chloroisopropyl)ether, benzene, and barium. Trends based on data from 2011 through 2016 are stable for 1,4-dioxane and barium, and are decreasing for benzene and bis(2-chloroisopropyl)ether.

4.2.3 Greenhouse Area

The May and December 2016 analytical data for the Greenhouse Area showed that tetrachloroethene (PCE) concentrations exceeded the screening level in WVU-MW04 (Figure 4-9). No other VOCs exceeded screening levels in the Greenhouse Area in 2016.

Mann-Kendall statistical tests were performed using groundwater analytical data collected at the two Greenhouse Area monitoring wells for two key constituents (PCE and trichloroethene); the results of Mann-Kendall statistical tests along with graphs showing concentrations over time are provided in Appendix B. The key constituents for the Greenhouse Area showed stable or decreasing trends.

SECTION 5

Summary

Groundwater monitoring for Ward Hollow and the Greenhouse Area in 2016 shows that groundwater flow patterns have remained stable and are consistent with the conceptual site model presented in the CCR (CH2M 2008).

Analytical data collected from 2003 through 2016 for Ward Hollow generally show that bis(2-chloroisopropyl)ether and benzene have a similar distribution and concentrations are below their respective screening level in the downgradient monitoring wells. However, 1,4-dioxane and barium were detected in one of the downgradient wells (MW-31) above their respective screening levels. 1,4-Dioxane has exhibited a slightly increasing trend in MW-31 since 2012, although exceedances are within its historical range. Barium has exhibited increasing concentrations at MW-31 since early 2014 and the observed exceedance during the December 2016 event is the first occurrence. Arsenic concentrations occasionally exceeded the screening level in some Ward Hollow monitoring wells; however, arsenic is most likely representative of naturally occurring levels. The groundwater concentration trends based on the Mann-Kendall statistical test for Ward Hollow were either stable or decreasing, except for the following:

- 1,4-Dioxane: increasing trend in one offsite monitoring well;
- Benzene: increasing trend in four onsite monitoring wells for all data but the trends are stable for data from 2011 through 2016
- Bis(2-chloroisopropyl)ether: increasing trend in two onsite monitoring wells for all data but the trends are stable for data from 2011 through 2016; and
- Barium: increasing trend in four monitoring wells for all data but only three monitoring wells show increasing trends for data from 2011 through 2016.

The 2016 analytical data for the Greenhouse Area show an exceedance of the screening level for PCE in WVU-MW04. No other VOCs exceeded screening levels in the Greenhouse Area in 2016. The key constituents for the Greenhouse Area showed stable/and or decreasing trends.

Monitoring well BW-02, which is not owned by UCC, was abandoned sometime after the September 2016 groundwater monitoring event. Concentrations of key constituents in BW-02 have been consistently below screening levels and the well appears to be outside the path of the groundwater plume; therefore, BW-02 is recommended to be removed from the GWMP.

Based on the results of monitoring conducted in 2016, it is recommended that a new monitoring be installed (depending on access) downgradient of MW-31 to better monitor the leading edge of the groundwater plume and that quarterly groundwater monitoring be continued in 2017. In addition, it is recommended that BW-02 be removed from the GWMP.

Dye testing was recently completed to better understand groundwater flow. In addition, soil sampling near MW-01 and groundwater sampling from new monitoring wells screened above bedrock was recently completed to evaluate if there is a source near MW-01. The results from these investigation activities will be provided as a separate report after the data has been evaluated.

SECTION 6

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Tables

Table 3-1. 2016 Groundwater and Surface Water Elevation Data

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

		May 2016		September 2016		December 2016	
Location	Top of Casing Elevation (ft amsl)	Water Level (ft btoc) 5/9/2016	Groundwater Elevation (ft amsl) 5/9/2016	Water Level (ft btoc) 9/6/2016	Groundwater Elevation (ft amsl) 9/6/2016	Water Level (ft btoc) 12/1/2016	Groundwater Elevation (ft amsl) 12/1/2016
Monitoring Wells							
MW-01	622.34	1.57	620.77	2.13	620.21	1.83	620.51
MW-02	775.88	82.29	693.59	83.32	692.56	82.70	693.18
MW-04	770.05	8.14	761.91	8.24	761.81	8.20	761.85
MW-05	800.71	31.67	769.04	33.85	766.86	33.49	767.22
MW-06	801.18	58.59	742.59	58.95	742.23	58.97	742.21
MW-20	608.85	0.82	608.03	1.81	607.04	0.92	607.93
MW-21	608.69	0.10	608.59	1.23	607.46	0.30	608.39
MW-22	608.73	6.20	602.53	6.59	602.14	5.87	602.86
MW-23	617.65	9.80	607.85	14.80	602.85	14.45	603.20
MW-24	604.07	7.02	597.05	7.84	596.23	7.74	596.33
MW-25	606.70	10.30	596.40	11.24	595.46	11.31	595.39
MW-26	635.37	27.59	607.78	28.69	606.68	27.61	607.76
MW-27	621.09	29.10	591.99	31.32	589.77	31.78	589.31
MW-28	622.45	30.30	592.15	32.59	589.86	33.01	589.44
MW-29	801.50	118.30	683.20	118.54	682.96	118.75	682.75
MW-30	620.19	25.94	594.25	25.34	594.85	26.20	593.99
MW-31	592.06	14.83	577.23	NM	NA	15.63	576.43
MW-32	589.05	17.96	571.09	NM	NA	16.45	572.60
MW-34	623.65	10.50	613.15	11.04	612.61	11.00	612.65
MW-35	615.46	6.34	609.12	7.31	608.15	6.38	609.08
BW-02	606.04	28.80	577.24	29.85	576.19	NM	NA
MW-104A	693.21	54.65	638.56	NM	NA	55.16	638.05
WVU-MW01	695.10	23.11	671.99	NM	NA	23.85	671.25
WVU-MW02	693.57	29.92	663.65	NM	NA	36.94	656.63
WVU-MW03	690.88	33.69	657.19	NM	NA	34.32	656.56
WVU-MW04	678.55	15.56	662.99	NM	NA	17.45	661.10
WVU-MW05	712.22	4.84	707.38	NM	NA	9.67	702.55
WVU-MW06	721.38	1.26	720.12	NM	NA	2.22	719.16

Table 3-1. 2016 Groundwater and Surface Water Elevation Data

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

		May 2016		September 2016		December 2016	
Location	**Top of Casing Elevation (ft amsl)**	**Water Level (ft btoc) 5/9/2016**	**Groundwater Elevation (ft amsl) 5/9/2016**	**Water Level (ft btoc) 9/6/2016**	**Groundwater Elevation (ft amsl) 9/6/2016**	**Water Level (ft btoc) 12/1/2016**	**Groundwater Elevation (ft amsl) 12/1/2016**
Piezometers							
P-06	784.00	8.84	775.16	8.83	775.17	8.78	775.22
P-11	767.20	6.73	760.47	8.79	758.41	9.39	757.81
P-13	769.90	98.29	671.61	29.70	740.20	98.03	671.87
P-14	770.70	44.71	725.99	44.79	725.91	45.05	725.65
Staff Gauges							
SG-01 (Next to MW-21)	599.00	-2.00	601.00	0.15	598.85	0.26	598.74
SG-02 (Next to MW-31)	584.00	3.86	580.14	3.21	580.79	3.44	580.56

Notes:

ft btoc = feet below top of casing

ft amsl = feet above mean sea level

Water level was not collected from BW-02 during the December event because the well was abandoned.

Water levels were not collected from MW-31 and MW-32 on 9/6/2016 due to high water in the area that prevented access to the wells.

NM = not measured

NA = not applicable or not available

Table 3-2. Well Construction Table

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location	Lithology in Screened Interval	Ground Elevation (ft amsl)	Screen Elevation (ft amsl)		Screened Interval (ft bgs)	
			Top	Bottom	Top	Bottom
Monitoring Wells						
MW-01	Siltstone and Shale above Upper Freeport	621.91	613	598	9	24
MW-02	Mahoning Sandstone	773.54	654	634	120	140
MW-04	Conemaugh Red Beds	770.84	745	735	26	36
MW-05	Red and Gray Claystone and Shale	799.45	761	741	38	58
MW-06	Mahoning Sandstone	799.59	680	660	120	140
MW-20	Upper Freeport Sandstone (deep)	606.61	548.1	529.1	58.5	77.5
MW-21	Upper Freeport Sandstone	606.80	578.7	558.7	28.1	48.1
MW-22	Siltstone and Shale above Upper Freeport	606.96	596.46	576.46	10.50	30.50
MW-23	Upper Freeport Sandstone	614.51	NA	545.65	NA	68.86
MW-24	Upper Freeport Sandstone	600.95	NA	546.15	NA	54.80
MW-25	Upper Freeport Sandstone	603.52	NA	543.64	NA	59.88
MW-26	Upper Freeport Sandstone	632.28	568	548	64	84
MW-27	Upper Freeport Sandstone	618.21	558	538	60	80
MW-28	Upper Freeport Sandstone	619.55	562	542	58	78
MW-29	Upper Freeport Sandstone	799.63	610	590	190	210
MW-30	Upper Freeport Sandstone	620.51	556	536	65	85
MW-31	Upper Freeport Sandstone	590.26	540.07	520.07	50.19	70.19
MW-32	Upper Freeport Sandstone	587.34	529.02	508.72	58.32	78.62
MW-34	Upper Freeport Sandstone	620.95	565.5	545.5	55.5	75.5
MW-35	Upper Freeport Sandstone	612.73	569	549	44	64
BW-02	Upper Freeport Sandstone	606.38	527.96	517.96	78.42	88.42
MW-104A	Mahoning Sandstone	694*	634	614	60	80
WVU-MW01	Mahoning Sandstone	695.3*	689.3	659.3	6	36
WVU-MW02	Mahoning Sandstone	693.8*	666.8	646.8	27	47
WVU-MW03	Mahoning Sandstone	691*	654	634	37	57
WVU-MW04	Mahoning Sandstone	678.8*	657.3	637.3	21.5	41.5
WVU-MW05	Shale above the Mahoning Sandstone	712.5*	704.5	684.5	8	28
WVU-MW06	Mahoning Sandstone	721.5*	711.5	691.5	10	30

Table 3-2. Well Construction Table

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location	Lithology in Screened Interval	Ground Elevation (ft amsl)	Screen Elevation (ft amsl)		Screened Interval (ft bgs)	
			Top	Bottom	Top	Bottom
Technology Park Piezometers						
P-06	Clay and Siltstone	781.59	764	762	18	20
P-11	Landfill Waste	765.14	747	745	18	20
P-13	Clay and Siltstone	768.07	670	668	98	100
P-14	Claystone	768.12	721.6	719.6	46.5	48.5

Notes:

NA = Not Available

ft bgs = feet below ground surface

ft amsl = feet above mean seal level

* = Estimated value. Survey data not available

Table 3-3. 2016 Groundwater Sampling Summary

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

				Analysis		
Monitoring Well	**Well Type**	**Sample ID**	**Date Sampled**	**VOCs**	**SVOCs**	**Dissolved Metals**
MW-01	Impacted	MW01-GW-MMDDYY	5/13/2016, 9/9/2016, 12/7/2016	X	X	X
MW-21	Impacted	MW21-GW-MMDDYY	5/11/2016, 9/8/2016, 12/7/2016	X	X	X
MW-23	Sentinel	MW23-GW-MMDDYY	5/12/2016, 9/8/2016, 12/7/2016	X	X	X
MW-26	Sentinel	MW26-GW-MMDDYY	5/11/2016, 9/7/2016, 12/6/2016	X	X	X
MW-28	Sentinel	MW28-GW-MMDDYY	5/12/2016, 9/8/2016, 12/5/2016	X	X	X
MW-31	Downgradient	MW31-GW-MMDDYY	5/10/2016, 9/9/2016, 12/9/2016	X	X	X
MW-32	Downgradient	MW32-GW-MMDDYY	5/12/2016, 9/9/2016, 12/9/2016	X	X	X
MW-34	Impacted	MW34-GW-MMDDYY	5/13/2016, 9/8/2016, 12/8/2016	X	X	X
MW-35	Impacted	MW35-GW-MMDDYY	5/12/2016, 9/8/2016, 12/7/2016	X	X	X
BW-02	Downgradient	BW02-GW-MMDDYY	5/11/2016, 9/7/2016	X	X	X
WVU-MW04	Impacted	WVU04-GW-MMDDYY	5/13/2016, 12/2/2016	X		
MW-104A	Impacted	MW104A-GW-MMDDYY	5/13/2016, 12/2/2016	X		

Notes:

VOCs = Volatile Organic Compounds.

SVOCs = Semivolatile Organic Compounds.

Groundwater samples were not collected from BW-02 in December because the well was abandoned.

Table 4-1. 2016 Detected Results for Ward Hollow Groundwater

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location			BW02		MW01			
Sample ID			BW02-GW-051116	BW02-GW-090716	MW01-GW-051316	MW01-GW-090916	MW01-GW-090916D	MW01-GW-120716
Sample Date			5/11/2016	9/7/2016	5/13/2016	9/9/2016	9/9/2016	12/7/2016
Analyte	**Screening Level**	**Screening Level Source**						
Metals (mg/L)								
Arsenic	0.01	MCL	**0.0117**	**0.0337**	0.01 U	0.01 U	0.01 U	0.01 U
Barium	2	MCL	**0.074**	**0.111**	**52.2**	**53.1**	**52.9**	**53.2**
Cadmium	0.005	MCL	0.001 U	0.001 U	**0.00731**	**0.00788**	**0.00813**	**0.00931**
Chromium, total	0.1	MCL	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.0173**
Lead	0.015	MCL	0.01 U	0.01 U	0.01 U	**0.0132**	**0.0105**	0.01 U
Selenium	0.05	MCL	0.001 U	0.01 U	**0.0418**	**0.0186**	**0.0191**	**0.00724**
SVOC (µg/L)								
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	0.538 U	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	0.538 UL	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
3 & 4 Methylphenol	--	--	0.538 U	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Acenaphthene	53	Adjusted Tapwater RSL	0.538 UL	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Acenaphthylene	--	--	0.538 UL	0.568 UL	5.49 U	6.41 UL	6.33 UL	5.49 U
Anthracene	180	Adjusted Tapwater RSL	0.538 U	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	0.538 U	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	0.538 UL	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	**1.23**	0.568 U	**651**	**412**	**453**	**504**
Diethyl Phthalate	1500	Adjusted Tapwater RSL	0.538 U	**4.08**	5.49 U	6.41 U	6.33 U	5.49 U
Fluoranthene	80	Adjusted Tapwater RSL	0.538 U	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Fluorene	29	Adjusted Tapwater RSL	0.538 UL	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Naphthalene	0.17	Adjusted Tapwater RSL	0.538 UL	0.568 U	**12**	**8.59**	**8.61**	**10.1**
Phenanthrene	--	--	0.538 U	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Phenol	580	Adjusted Tapwater RSL	0.538 U	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
VOC (µg/L)								
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U	**3.12**	**2.92**	1 U
1,2-Dichlorobenzene	600	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	1.08 U	100 UJ	**274 L**	**207 L**	**228 L**	**150**
Acetone	1400	Adjusted Tapwater RSL	5 UL	5 UL	**38.2 L**	**8.64 J**	**7.37 J**	5 UL
Benzene	5	MCL	1 U	1 U	**28.1**	**28**	**28.9**	**33.3 L**
Carbon Disulfide	81	MCL	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	700	MCL	1 U	1 U	**21.2**	**22.5**	**24.2**	**25.9**
2-Butanone	560	Adjusted Tapwater RSL	5 U	5 UL	5 U	5 U	5 U	5 UL
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	5 U	5 UL	5 U	5 U	5 U	5 UL
Pyrene	12	Adjusted Tapwater RSL	0.538 U	0.568 U	5.49 U	6.41 U	6.33 U	5.49 U
Styrene	100	MCL	1 U	**1.03**	1 U	1 U	1 U	1 U
Toluene	1000	MCL	1 U	1 U	**2.94**	**2.83**	**2.95**	**3.27**
Xylenes, total	10000	MCL	1 U	1 U	**8.75**	**8.97**	**9.66**	**9.64**

Table 4-1. 2016 Detected Results for Ward Hollow Groundwater

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location			MW21			MW23			
Sample ID			MW21-GW-051116	MW021-GW-090816	MW21-GW-120716	MW23-GW-051216	MW023-GW-090816	MW023-GW-090816D	MW23-GW-120716
Sample Date			5/11/2016	9/8/2016	12/7/2016	5/12/2016	9/8/2016	9/8/2016	12/7/2016
Analyte	**Screening Level**	**Screening Level Source**							
Metals (mg/L)									
Arsenic	0.01	MCL	0.01 U	0.01 U	0.01 U	0.01 U	**0.0198**	**0.0231**	0.01 U
Barium	2	MCL	**46.7**	**54.8**	**49.4**	**51.7**	**44**	**43.7**	**43.3**
Cadmium	0.005	MCL	**0.00695**	**0.00803**	**0.0084**	**0.00758**	**0.00744**	**0.00749**	**0.00939**
Chromium, total	0.1	MCL	0.005 U	0.005 U	**0.0248**	**0.00789**	0.005 U	0.005 U	0.005 U
Lead	0.015	MCL	0.01 U	**0.011**	**0.012**	0.01 U	**0.011**	**0.0139**	0.01 U
Selenium	0.05	MCL	**0.0277**	**0.0161**	**0.00691**	**0.0247**	**0.014**	**0.0167**	**0.0135**
SVOC (µg/L)									
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	0.515 UL	2.91 U	6.41 U	0.568 UL	1.1 U	2.78 U	6.02 U
3 & 4 Methylphenol	--	--	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
Acenaphthene	53	Adjusted Tapwater RSL	0.515 UL	2.91 U	6.41 U	0.568 UL	1.1 U	2.78 U	6.02 U
Acenaphthylene	--	--	0.515 UL	2.91 UL	6.41 U	0.568 UL	1.1 UL	2.78 UL	6.02 U
Anthracene	180	Adjusted Tapwater RSL	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	**1.25 L**	2.91 U	6.41 U	**1.98 L**	1.1 U	2.78 U	6.02 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	**217**	**366**	**450**	**385**	**282**	**351**	**337**
Diethyl Phthalate	1500	Adjusted Tapwater RSL	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
Fluoranthene	80	Adjusted Tapwater RSL	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
Fluorene	29	Adjusted Tapwater RSL	0.515 UL	2.91 U	6.41 U	0.568 UL	1.1 U	2.78 U	6.02 U
Naphthalene	0.17	Adjusted Tapwater RSL	**0.571 L**	2.91 U	6.41 U	0.568 UL	1.1 U	2.78 U	6.02 U
Phenanthrene	--	--	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
Phenol	580	Adjusted Tapwater RSL	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
VOC (µg/L)									
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	600	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	**220 L**	**257**	**152**	**278 L**	**230**	**255**	**154**
Acetone	1400	Adjusted Tapwater RSL	**36.2 L**	5 UL	5 UL	**38.4 L**	**9.1 L**	**9.42 L**	**7.81 L**
Benzene	5	MCL	**21.3 L**	**20.2 L**	**23.4**	**8.21**	**5.6**	**5.7**	**6.13**
Carbon Disulfide	81	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	700	MCL	**5.79**	**4.59**	**5.88**	**1.13**	1 U	1 U	1 U
2-Butanone	560	Adjusted Tapwater RSL	**6.28**	5 UL	5 UL	5 U	5 UL	5 UL	5 UL
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	5 U	5 UL	5 UL	5 U	5 UL	5 UL	5 UL
Pyrene	12	Adjusted Tapwater RSL	0.515 U	2.91 U	6.41 U	0.568 U	1.1 U	2.78 U	6.02 U
Styrene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1000	MCL	**1.79**	**1.59**	**1.92**	1 U	1 U	1 U	1 U
Xylenes, total	10000	MCL	**3.35**	**2.74**	**3.02**	1 U	1 U	1 U	1 U

Table 4-1. 2016 Detected Results for Ward Hollow Groundwater

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location			MW26			MW28			
Sample ID			MW26-GW-051116	MW026-GW-090716	MW26-GW-120616	MW28-GW-051216	MW28-GW-051216D	MW028-GW-090816	MW28-GW-120516
Sample Date			5/11/2016	9/7/2016	12/6/2016	5/12/2016	5/12/2016	9/8/2016	12/5/2016
Analyte	**Screening Level**	**Screening Level Source**							
Metals (mg/L)									
Arsenic	0.01	MCL	0.01 U	0.01 U	**0.0148**	0.01 U	0.01 U	**0.0148**	0.01 U
Barium	2	MCL	**55**	**59**	**57**	**36.3**	**37.8**	**35.3**	**32.8**
Cadmium	0.005	MCL	**0.0074**	**0.00816**	**0.00993**	**0.00574**	**0.00638**	**0.00651**	**0.00635**
Chromium, total	0.1	MCL	0.005 U	0.005 U	0.005 U	**0.005**	0.005 U	**0.00543**	0.005 U
Lead	0.015	MCL	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	**0.0144**	0.01 U
Selenium	0.05	MCL	**0.0303**	**0.0211**	**0.015**	**0.0201**	**0.0182**	**0.0141**	**0.0152**
SVOC (µg/L)									
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	0.556 UL	2.81 U	6.33 U	0.595 UL	0.543 UL	3.29 U	5.38 U
3 & 4 Methylphenol	--	--	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
Acenaphthene	53	Adjusted Tapwater RSL	0.556 UL	2.81 U	6.33 U	0.595 UL	0.543 UL	3.29 U	5.38 U
Acenaphthylene	--	--	0.556 UL	2.81 UL	6.33 U	0.595 UL	0.543 UL	3.29 UL	5.38 U
Anthracene	180	Adjusted Tapwater RSL	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	**1.6 L**	2.81 U	6.33 U	0.595 UL	0.543 UL	3.29 U	5.38 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	**304**	**381**	**458**	**197**	**174**	**108**	**136**
Diethyl Phthalate	1500	Adjusted Tapwater RSL	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
Fluoranthene	80	Adjusted Tapwater RSL	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
Fluorene	29	Adjusted Tapwater RSL	0.556 UL	2.81 U	6.33 U	0.595 UL	0.543 UL	3.29 U	5.38 U
Naphthalene	0.17	Adjusted Tapwater RSL	0.556 UL	2.81 U	6.33 U	0.595 UL	0.543 UL	3.29 U	5.38 U
Phenanthrene	--	--	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
Phenol	580	Adjusted Tapwater RSL	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
VOC (µg/L)									
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	600	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	**195 L**	**233**	**196**	**240 L**	**202 L**	**206**	**134**
Acetone	1400	Adjusted Tapwater RSL	**39 L**	5 UL	5 UL	**18.1 L**	**17.2 L**	5 UL	5 UL
Benzene	5	MCL	**17**	**18.8**	**19.4**	**2.77**	**2.75**	**2.79**	**2.57**
Carbon Disulfide	81	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	700	MCL	**2.29**	**2.4**	**2.82**	1 U	1 U	1 U	1 U
2-Butanone	560	Adjusted Tapwater RSL	5 U	5 UL	5 UL	5 U	5 U	5 UL	5 UL
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	5 U	5 UL	5 UL	5 U	5 U	5 UL	5 UL
Pyrene	12	Adjusted Tapwater RSL	0.556 U	2.81 U	6.33 U	0.595 U	0.543 U	3.29 U	5.38 U
Styrene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1000	MCL	**1.18**	**1.34**	**1.43**	1 U	1 U	1 U	1 U
Xylenes, total	10000	MCL	**1.93**	**2.08**	**2.01**	1 U	1 U	1 U	1 U

Table 4-1. 2016 Detected Results for Ward Hollow Groundwater

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location			MW31			MW32		
Sample ID			MW31-GW-051016	MW031-GW-090916	MW31-GW-120916	MW32-GW-051116	MW032-GW-090916	MW32-GW-120916
Sample Date			5/10/2016	9/9/2016	12/9/2016	5/11/2016	9/9/2016	12/9/2016
Analyte	**Screening Level**	**Screening Level Source**						
Metals (mg/L)								
Arsenic	0.01	MCL	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Barium	2	MCL	**1**	**0.633**	**2**	**0.211**	**0.208**	**0.145**
Cadmium	0.005	MCL	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, total	0.1	MCL	0.005 U	**0.00831**	0.005 U	0.005 U	0.005 U	0.005 U
Lead	0.015	MCL	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Selenium	0.05	MCL	**0.00532**	0.01 U	**0.00752**	0.001 U	0.01 U	0.001 U
SVOC (µg/L)								
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	0.575 UL	0.633 U	0.532 U	0.538 UL	0.543 U	0.581 U
3 & 4 Methylphenol	--	--	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
Acenaphthene	53	Adjusted Tapwater RSL	0.575 UL	0.633 U	0.532 U	0.538 UL	0.543 U	0.581 U
Acenaphthylene	--	--	0.575 UL	0.633 UL	0.532 U	0.538 UL	0.543 UL	0.581 U
Anthracene	180	Adjusted Tapwater RSL	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	0.575 UL	0.633 U	0.532 U	0.538 UL	0.543 U	0.581 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	0.575 U	**0.772**	**1.31**	0.538 U	**1.21**	0.581 U
Diethyl Phthalate	1500	Adjusted Tapwater RSL	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
Fluoranthene	80	Adjusted Tapwater RSL	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
Fluorene	29	Adjusted Tapwater RSL	0.575 UL	0.633 U	0.532 U	0.538 UL	0.543 U	0.581 U
Naphthalene	0.17	Adjusted Tapwater RSL	0.575 UL	0.633 U	0.532 U	0.538 UL	0.543 U	0.581 U
Phenanthrene	--	--	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
Phenol	580	Adjusted Tapwater RSL	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
VOC (µg/L)								
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	600	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	**8.52**	**7.2 J**	**15 L**	1.08 U	0.21 UJ	0.22 UL
Acetone	1400	Adjusted Tapwater RSL	**5.58 L**	5 U	5 U	**85.4 L**	**8.11 J**	**30.3**
Benzene	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Disulfide	81	MCL	1 U	1 U	1 UJ	1 U	1 U	1 UJ
Chlorobenzene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	700	MCL	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	560	Adjusted Tapwater RSL	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	5 U	5 U	5 U	5 U	5 U	5 U
Pyrene	12	Adjusted Tapwater RSL	0.575 U	0.633 U	0.532 U	0.538 U	0.543 U	0.581 U
Styrene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1000	MCL	1 U	1 U	1 U	1 U	1 U	1 U
Xylenes, total	10000	MCL	1 U	1 U	1 U	1 U	1 U	1 U

Table 4-1. 2016 Detected Results for Ward Hollow Groundwater

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location			MW34			MW35		
Sample ID			MW34-GW-051316	MW034-GW-090816	MW34-GW-120816	MW35-GW-051216	MW035-GW-090816	MW35-GW-120716
Sample Date			5/13/2016	9/8/2016	12/8/2016	5/12/2016	9/8/2016	12/7/2016
Analyte	**Screening Level**	**Screening Level Source**						
Metals (mg/L)								
Arsenic	0.01	MCL	0.01 U	0.01 U	**0.0101**	0.01 U	0.01 U	0.01 U
Barium	2	MCL	**38.6**	**50.2**	**50.9**	**54.7**	**59.1**	**57**
Cadmium	0.005	MCL	**0.00494**	**0.00654**	**0.00746**	**0.00726**	**0.00826**	**0.00901**
Chromium, total	0.1	MCL	**0.00538**	0.005 U	0.005 U	0.005 U	0.005 U	**0.0303**
Lead	0.015	MCL	0.01 U	0.01 U	0.01 U	**0.0116**	0.01 U	0.01 U
Selenium	0.05	MCL	**0.0178**	**0.0165**	**0.00788**	**0.025**	**0.0164**	**0.0044**
SVOC (µg/L)								
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 U	3.21 U	5.38 U
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 UL	3.21 U	5.38 U
3 & 4 Methylphenol	--	--	0.568 U	2.91 U	5.26 U	0.521 U	3.21 U	5.38 U
Acenaphthene	53	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 UL	3.21 U	5.38 U
Acenaphthylene	--	--	0.568 U	2.91 UL	5.26 U	0.521 UL	3.21 UL	5.38 U
Anthracene	180	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 U	3.21 U	5.38 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	**0.566 K**	3.21 U	5.38 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	**1.21 L**	3.21 U	5.38 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	**16.4**	**21.9**	**14.8**	**248**	**321**	**524**
Diethyl Phthalate	1500	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 U	3.21 U	5.38 U
Fluoranthene	80	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 U	3.21 U	5.38 U
Fluorene	29	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 UL	3.21 U	5.38 U
Naphthalene	0.17	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 UL	3.21 U	5.38 U
Phenanthrene	--	--	0.568 U	2.91 U	5.26 U	0.521 U	3.21 U	5.38 U
Phenol	580	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 U	3.21 U	5.38 U
VOC (µg/L)								
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	600	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	**102 L**	**162**	**260 K**	**222 L**	**227**	**168**
Acetone	1400	Adjusted Tapwater RSL	**7.34**	5 UL	**9.05**	**33.2 L**	5 UL	5 UL
Benzene	5	MCL	1 U	1 U	1 UJ	**21.4**	**22**	**25**
Carbon Disulfide	81	MCL	**1.23 J**	1 U	1 UJ	1 U	1 U	1 U
Chlorobenzene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	700	MCL	1 U	1 U	1 U	**10.2**	**8.33**	**9.74**
2-Butanone	560	Adjusted Tapwater RSL	5 U	5 UL	5 U	5 U	5 UL	5 UL
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	5 U	5 UL	5 U	5 U	5 UL	5 UL
Pyrene	12	Adjusted Tapwater RSL	0.568 U	2.91 U	5.26 U	0.521 U	3.21 U	5.38 U
Styrene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1000	MCL	1 U	1 U	**1.29**	**2.05**	**2.02**	**2.27**
Xylenes, total	10000	MCL	1 U	1 U	1 U	**3.94**	**3.45**	**3.36**

Table 4-1. 2016 Detected Results for Ward Hollow Groundwater

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location			Leachate Collection System		
Sample ID			SW01-GW-051116	SW01-GW-090916	SW01-GW-120816
Sample Date			5/11/2016	9/9/2016	12/8/2016
Analyte	**Screening Level**	**Screening Level Source**			
Metals (mg/L)					
Arsenic	0.01	MCL	**0.0197**	**0.0556**	**0.0261**
Barium	2	MCL	**4.37**	**5.05**	**4.56**
Cadmium	0.005	MCL	**0.0033**	**0.00406**	**0.0042**
Chromium, total	0.1	MCL	0.005 U	0.005 U	0.005 U
Lead	0.015	MCL	0.01 U	**0.0103**	0.01 U
Selenium	0.05	MCL	**0.0218**	**0.0135**	**0.0154**
SVOC (µg/L)					
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	**64.1**	**61.1**	**87.2**
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	**54.8 L**	**41.6**	**66.8**
3 & 4 Methylphenol	--	--	**91.9**	**1030**	**108**
Acenaphthene	53	Adjusted Tapwater RSL	**30.7 L**	**29.3**	**32.4**
Acenaphthylene	--	--	**7.79 L**	**15.8 L**	**9.3**
Anthracene	180	Adjusted Tapwater RSL	5.88 U	**6.05**	5.56 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	5.88 U	2.5 U	5.56 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	5.88 UL	2.5 U	5.56 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	**746**	**390**	**853**
Diethyl Phthalate	1500	Adjusted Tapwater RSL	5.88 U	2.5 U	5.56 U
Fluoranthene	80	Adjusted Tapwater RSL	5.88 U	**4**	5.56 U
Fluorene	29	Adjusted Tapwater RSL	**23 L**	**26.5**	**23.6**
Naphthalene	0.17	Adjusted Tapwater RSL	**216 L**	**203**	**332**
Phenanthrene	--	--	**22**	**44.5**	**19**
Phenol	580	Adjusted Tapwater RSL	**350**	**216**	**432**
VOC (µg/L)					
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U
1,2-Dichlorobenzene	600	MCL	**1.71**	**2**	**1.62**
1,2-Dichloroethane	5	MCL	**14.9**	**16.7**	**14.8**
1,2-Dichloropropane	5	MCL	**77.9**	**59.8**	**72.6**
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	**124 L**	**210 L**	**211 K**
Acetone	1400	Adjusted Tapwater RSL	**144 L**	**178 J**	**133**
Benzene	5	MCL	**39**	**42.4**	**41.8**
Carbon Disulfide	81	MCL	1 U	1 U	**2.26 K**
Chlorobenzene	100	MCL	**3.12**	**3.27**	**2.94**
Ethylbenzene	700	MCL	**68.2**	**77.1**	**77.3**
2-Butanone	560	Adjusted Tapwater RSL	5 U	**11**	**9.59**
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	**25.5**	**23.2**	**24.6**
Pyrene	12	Adjusted Tapwater RSL	5.88 U	**6.2**	5.56 U
Styrene	100	MCL	**10.1**	**11.6**	**12**
Toluene	1000	MCL	**75.2**	**92.7**	**70.2**
Xylenes, total	10000	MCL	**60.1**	**76**	**72.6**

Table 4-1. 2016 Detected Results for Ward Hollow Groundwater

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Notes:

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
K = The analyte was positively identified, but the associated numerical value may be biased high.
L = The analyte was positively identified, but the associated numerical value may be biased low.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
UL = The analyte was analyzed for but was not detected. The quantitation limit may be biased low.
MCL= Maximum contaminant level
RSL= Regional screening level
mg/L = Millograms per Liter
µg/L = Micrograms per Liter
Shading indicates the result exceeded screening criteria.

Table 4-2. 2016 Detected Results for Greenhouse Area Groundwater

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location			MW-104A		WVU-MW04	
Sample ID			MW104A-GW-051316	MW104A-GW-120216	WVUMW04-GW-051316	WVUMW04-GW-120216
Sample Date		Screening Level	5/13/2016	12/2/2016	5/13/2016	12/12/2016
Analyte	Screening Level	Source				
VOCs (µg/L)						
Chloroform	80	MCL	1 U	1 U	**1.09**	**1.23**
cis-1,2-Dichloroethene	70	MCL	1 U	**1.79**	**1.54**	**1.39**
Tetrachloroethene	5	MCL	1 U	**2.6**	**28.3**	**21.3**
Trichloroethene	5	MCL	1 U	1 U	**3.24**	**2.55**

Notes:

A few analytes had reporting limits higher than screening levels; however, the sampling objectives were still achieved and these instances do not affect our ability to effectively monitor groundwater conditions at the site.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

µg/L = Micrograms per Liter

MCL= Maximum contaminant level

Bold indicates the analyte was detected

Shading indicates the result exceeded screening criteria.

Figures

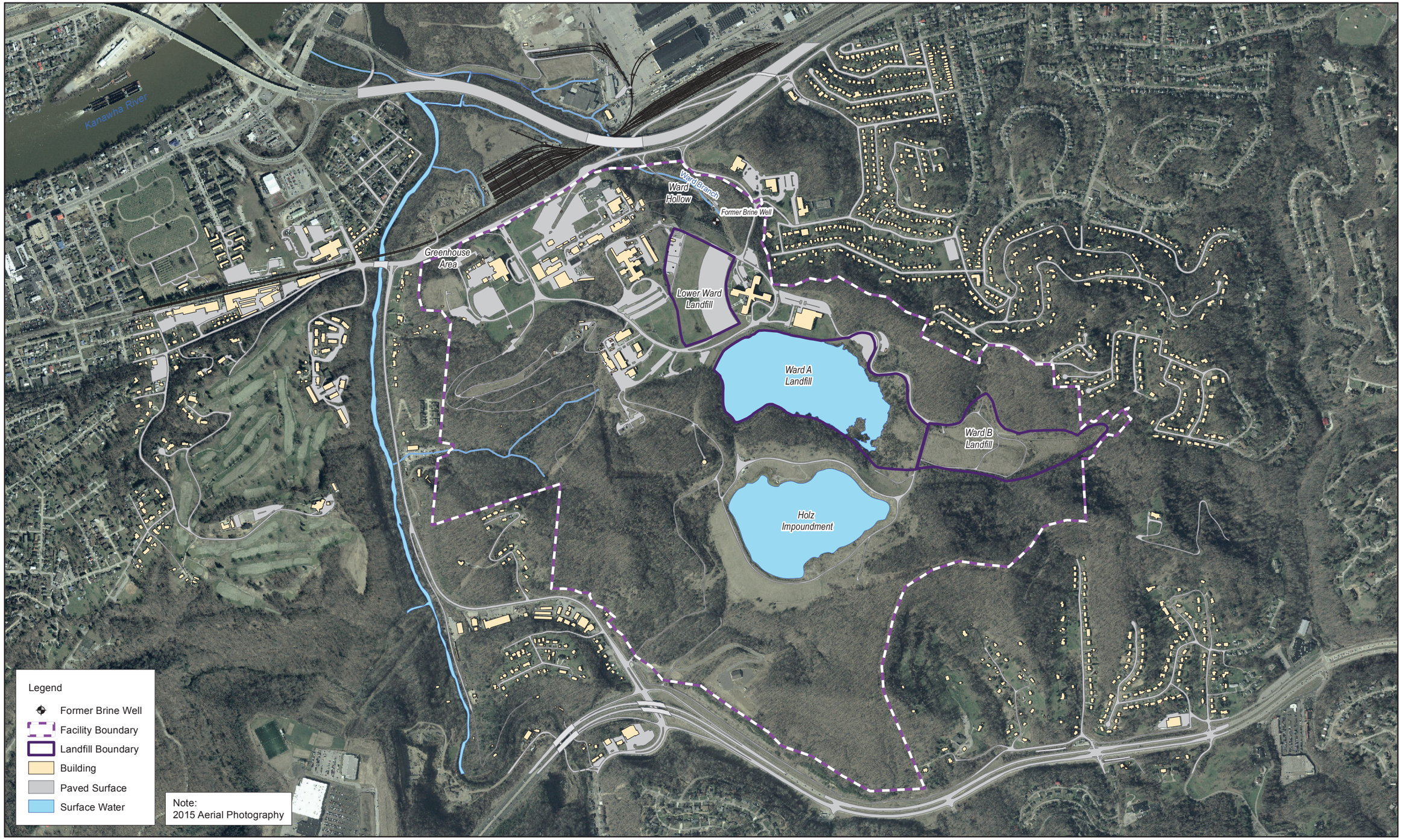

Figure 1-1
Facility Location Map
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

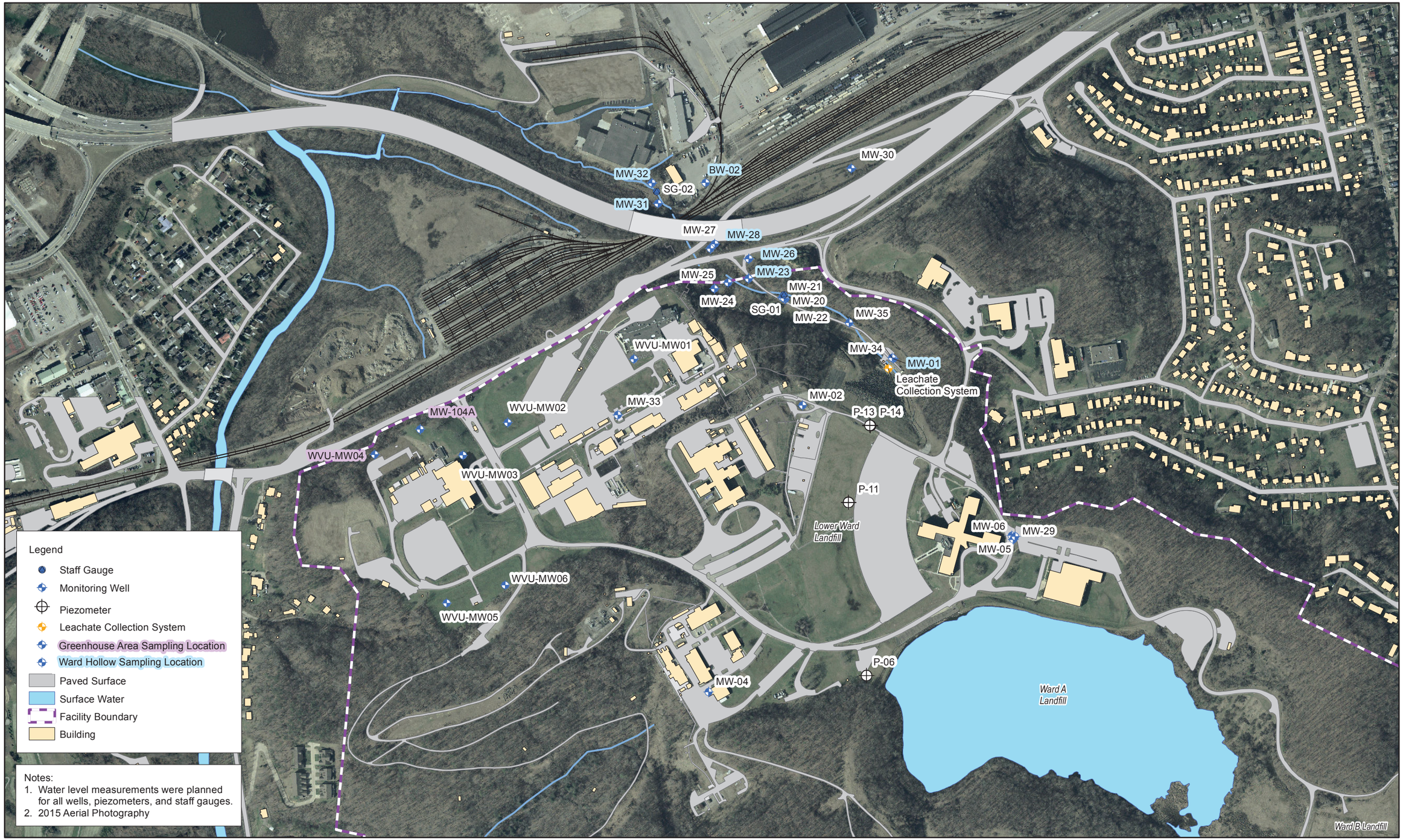

Figure 3-1
Water Level and Groundwater Sampling Locations
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

ch2m

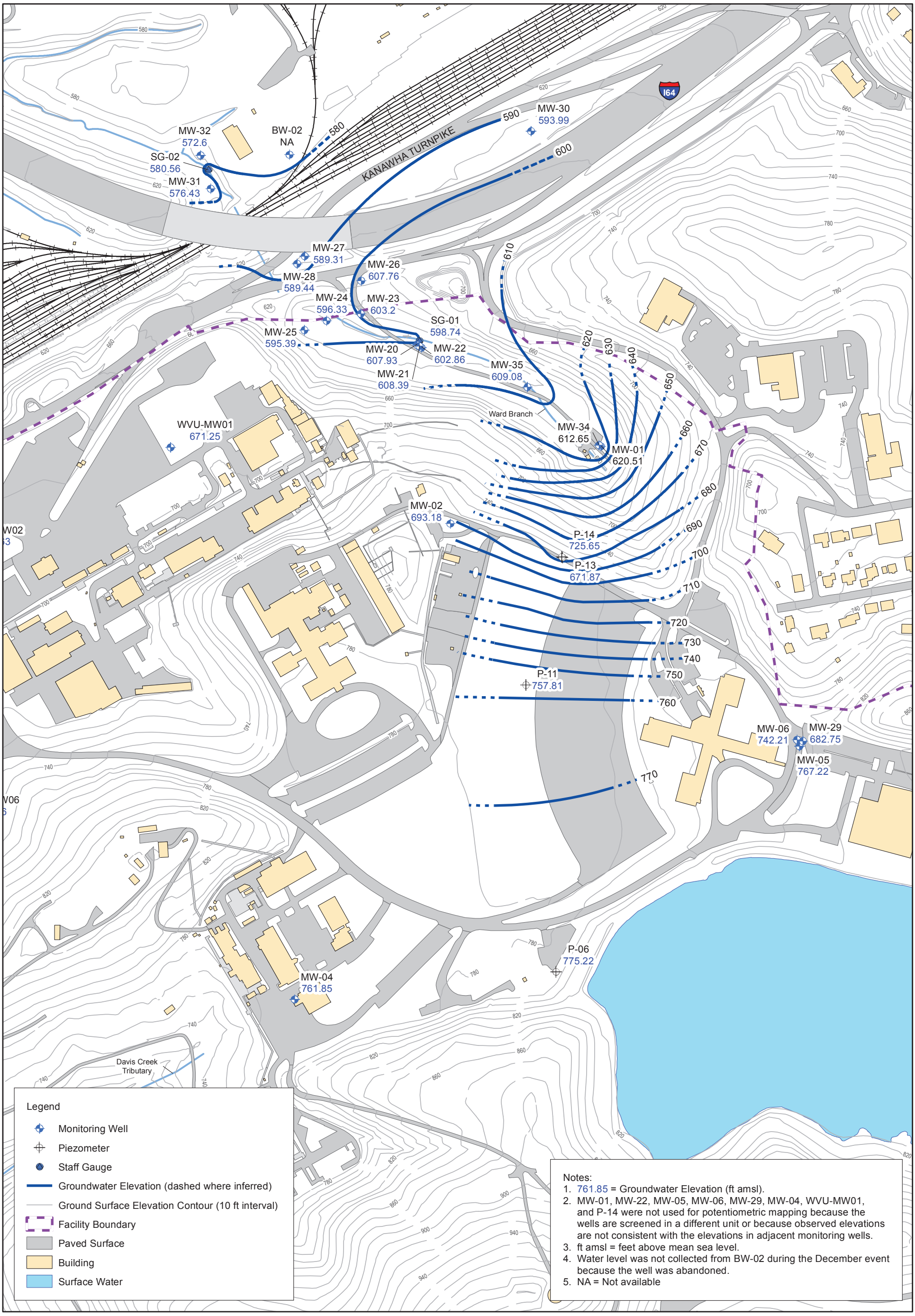

Figure 4-1
December 2016 Ward Hollow Upper Freeport Potentiometric Surface Map
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

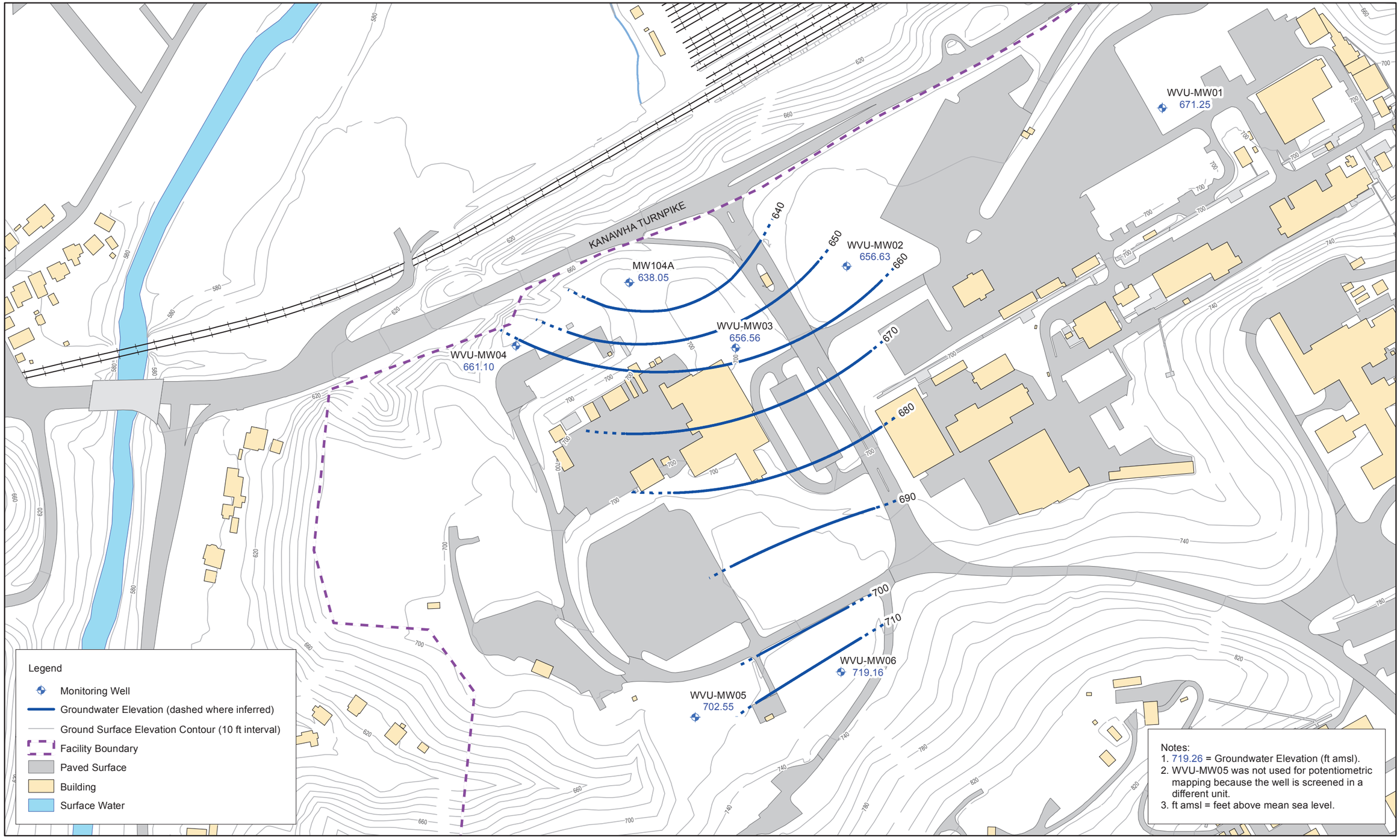

Figure 4-2
December 2016 Mahoning Sandstone Potentiometric Surface Near the Greenhouse Area
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

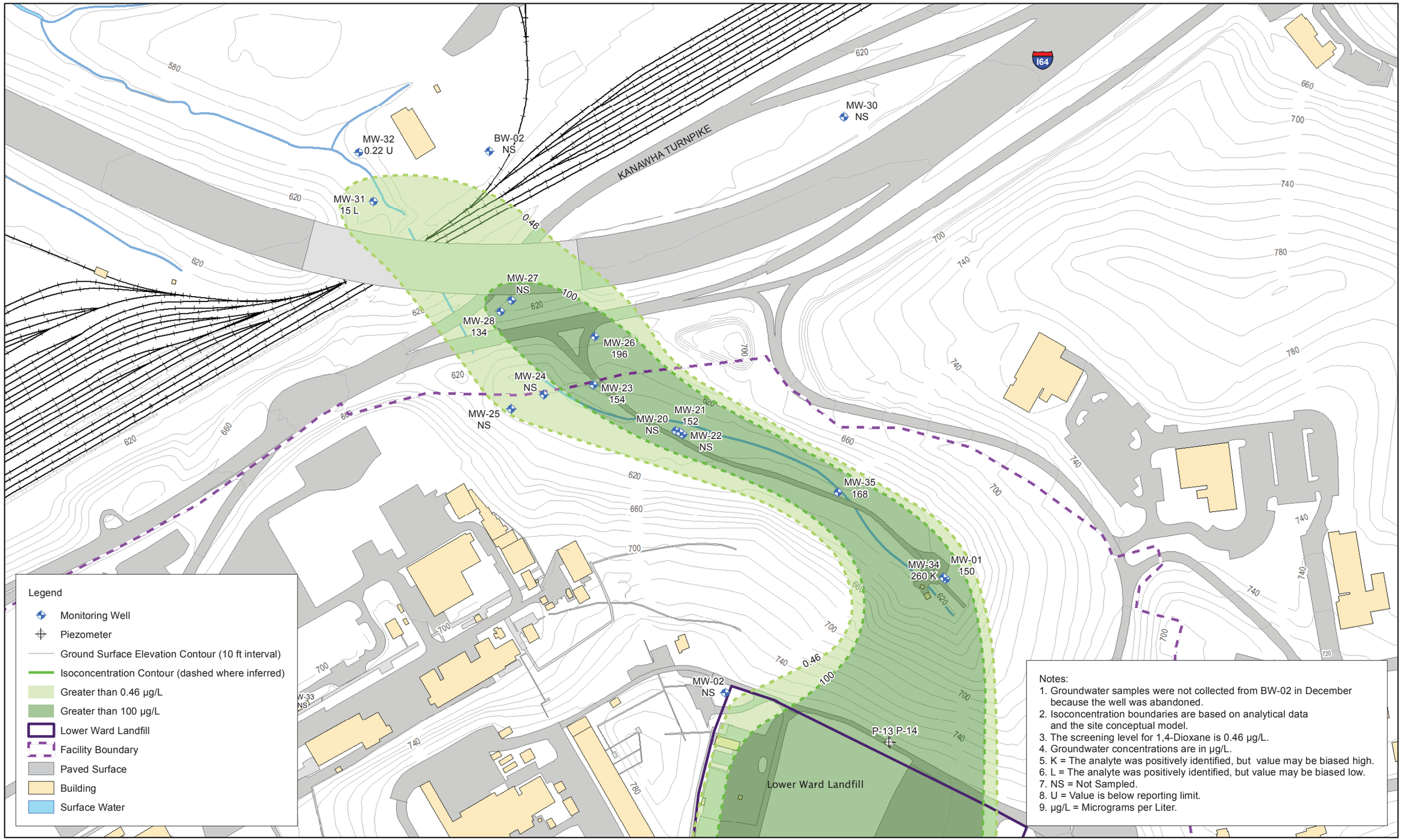

Figure 4-3
December 2016 1,4-Dioxane Isoconcentration Map
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

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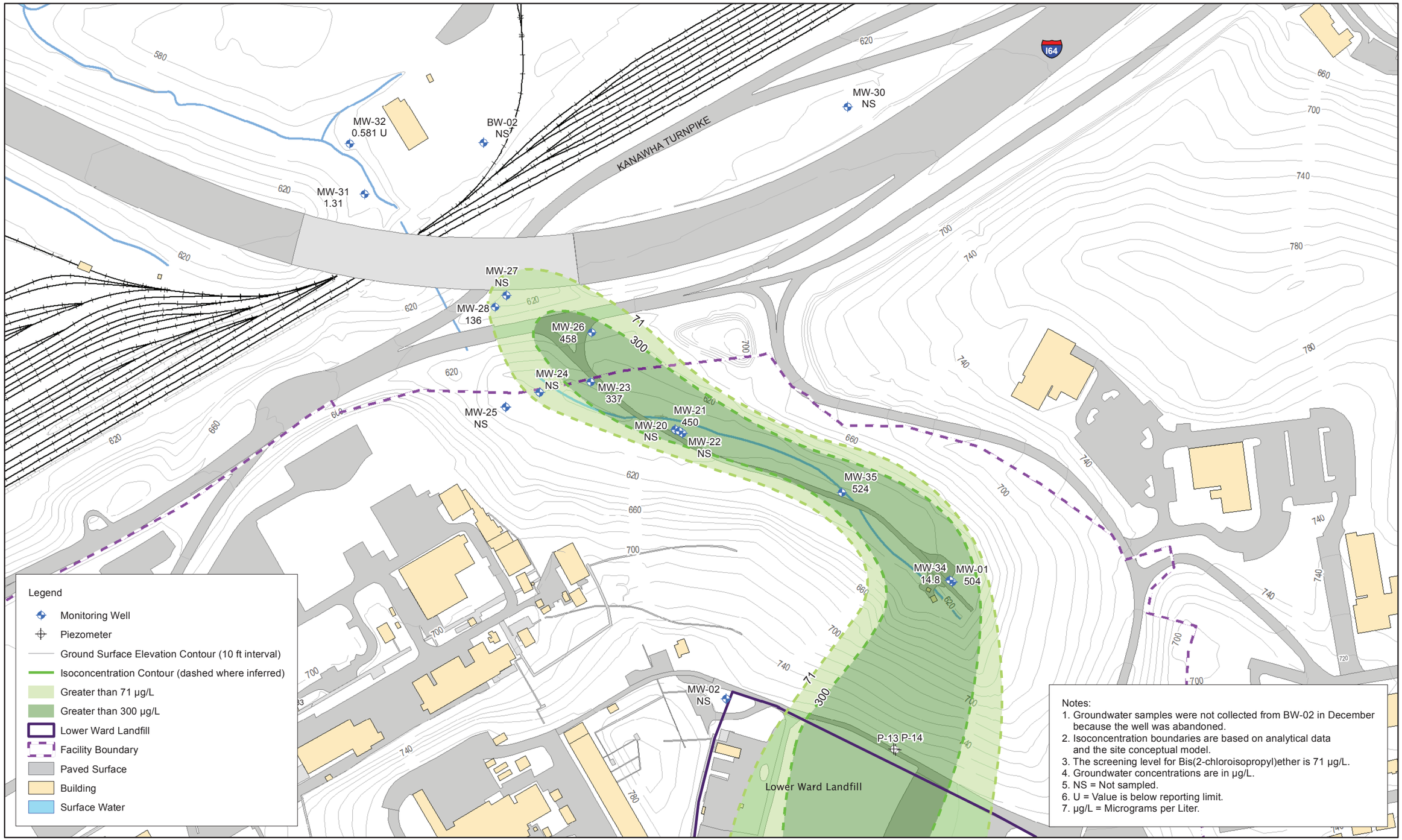

Figure 4-4
December 2016 Bis(2-chloroisopropyl)ether Isoconcentration Map
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

ch2m

\\LAKEFRONT\PROJ\GIS\DOW\TECHCENTER\REPORTS\2017\GWREPORT2016\MAPS\REPORT\FIGURE 04-04 - BIS(2-CHLOROISOPROPYL)ETHER ISOCONCENTRATION MAP.MXD JHANSEN1 3/9/2017 3:41:25 PM

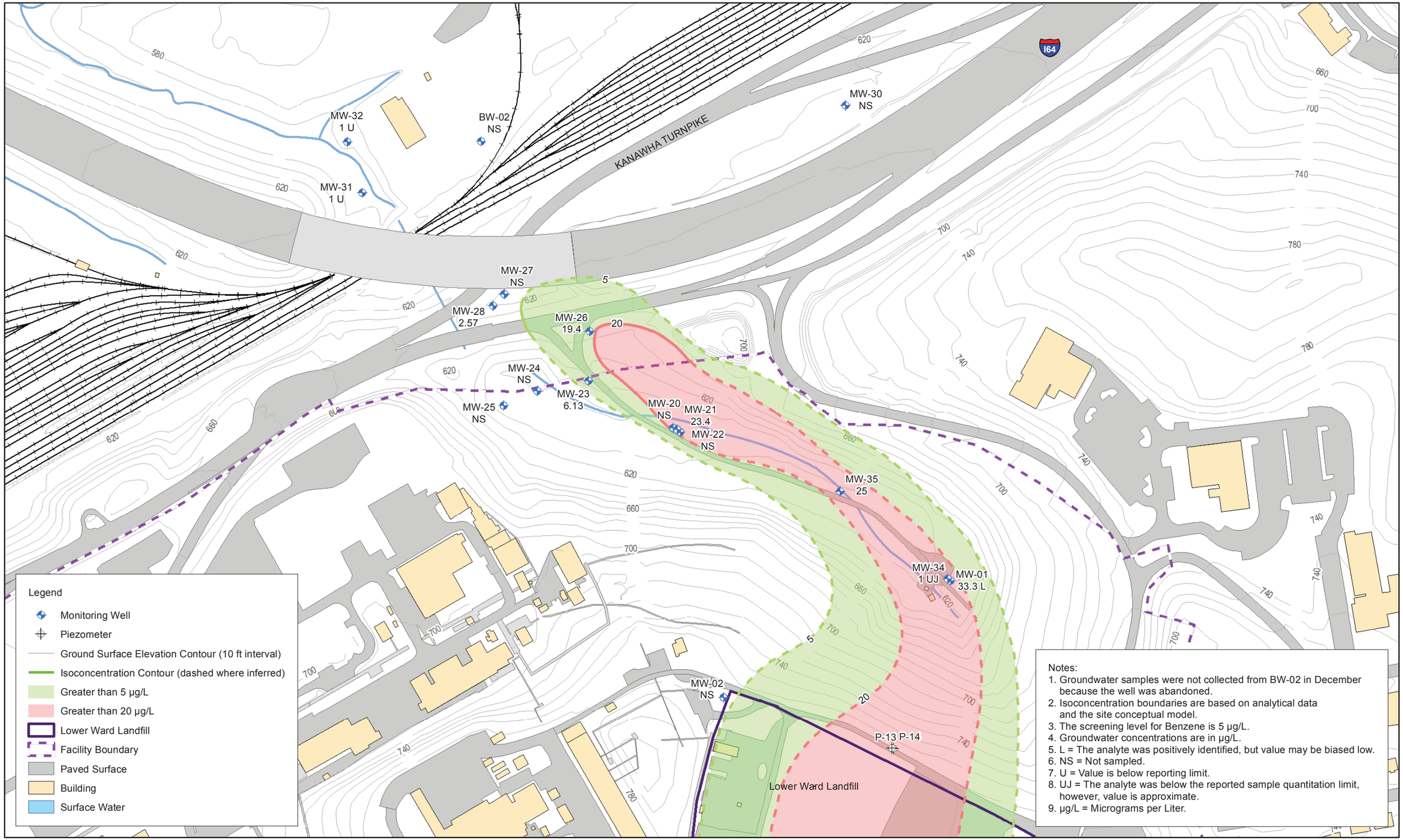

Figure 4-5
December 2016 Benzene Isoconcentration Map
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

\\LAKEFRONT\PROJ\GIS\DOW\TECHCENTER\REPORTS\2017\GWREPORT2016\MAPS\REPORT\FIGURE 04-05 - BENZENE ISOCONCENTRATION MAP.MXD JHANSEN1 3/9/2017 3:43:09 PM

Figure 4-6
December 2016 Dissolved Barium Isoconcentration Map
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

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\\LAKEFRONT\PROJ\GIS\DOW\TECHCENTER\REPORTS\2017\GWREPORT2016\MAPS\REPORT\FIGURE 04-06 - DISSOLVED BARIUM ISOCONCENTRATION MAP.MXD JHANSEN1 3/9/2017 3:46:40 PM

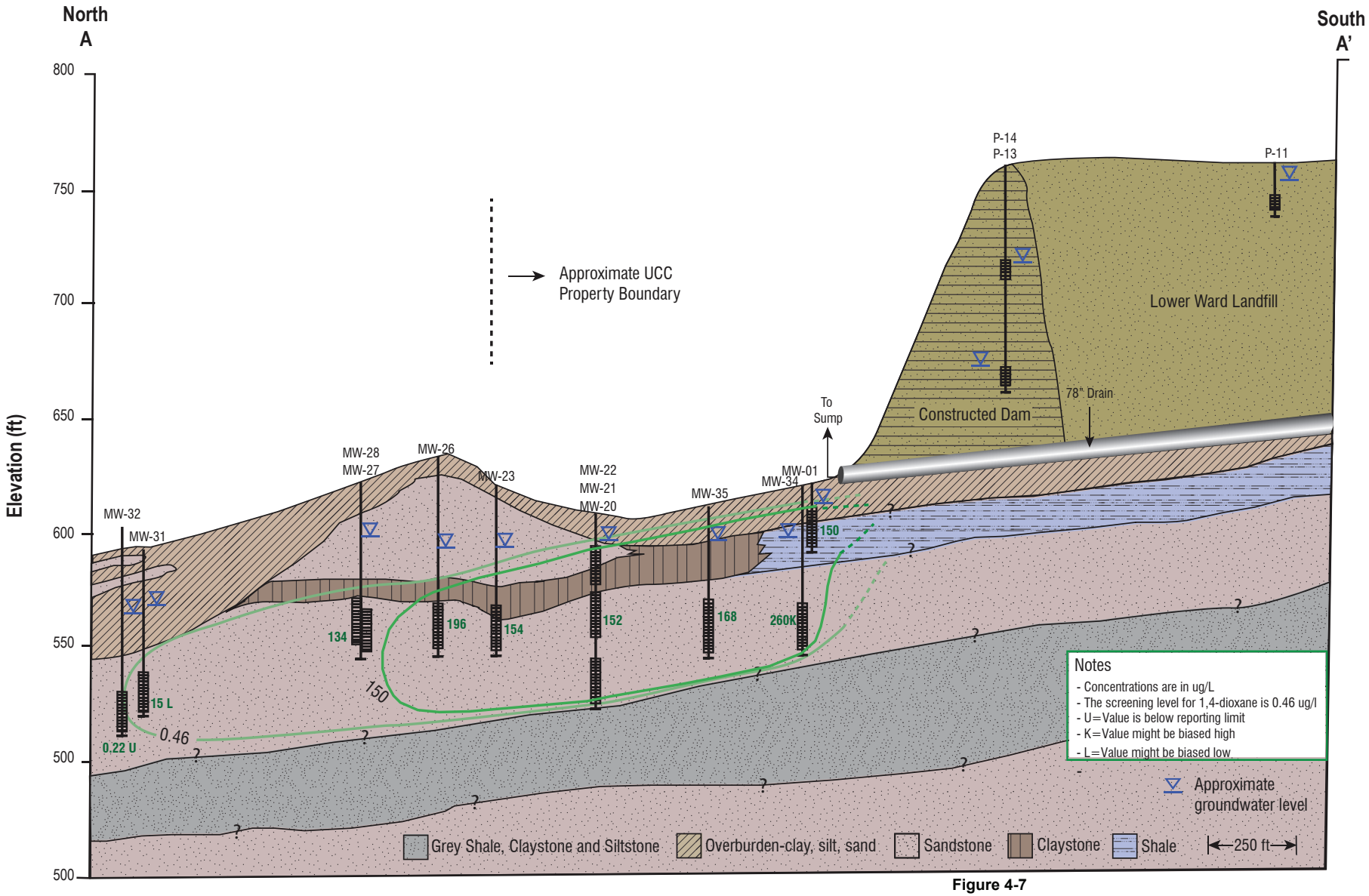


Figure 4-7
December 2016 1,4-Dioxane Vertical Extent Map
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

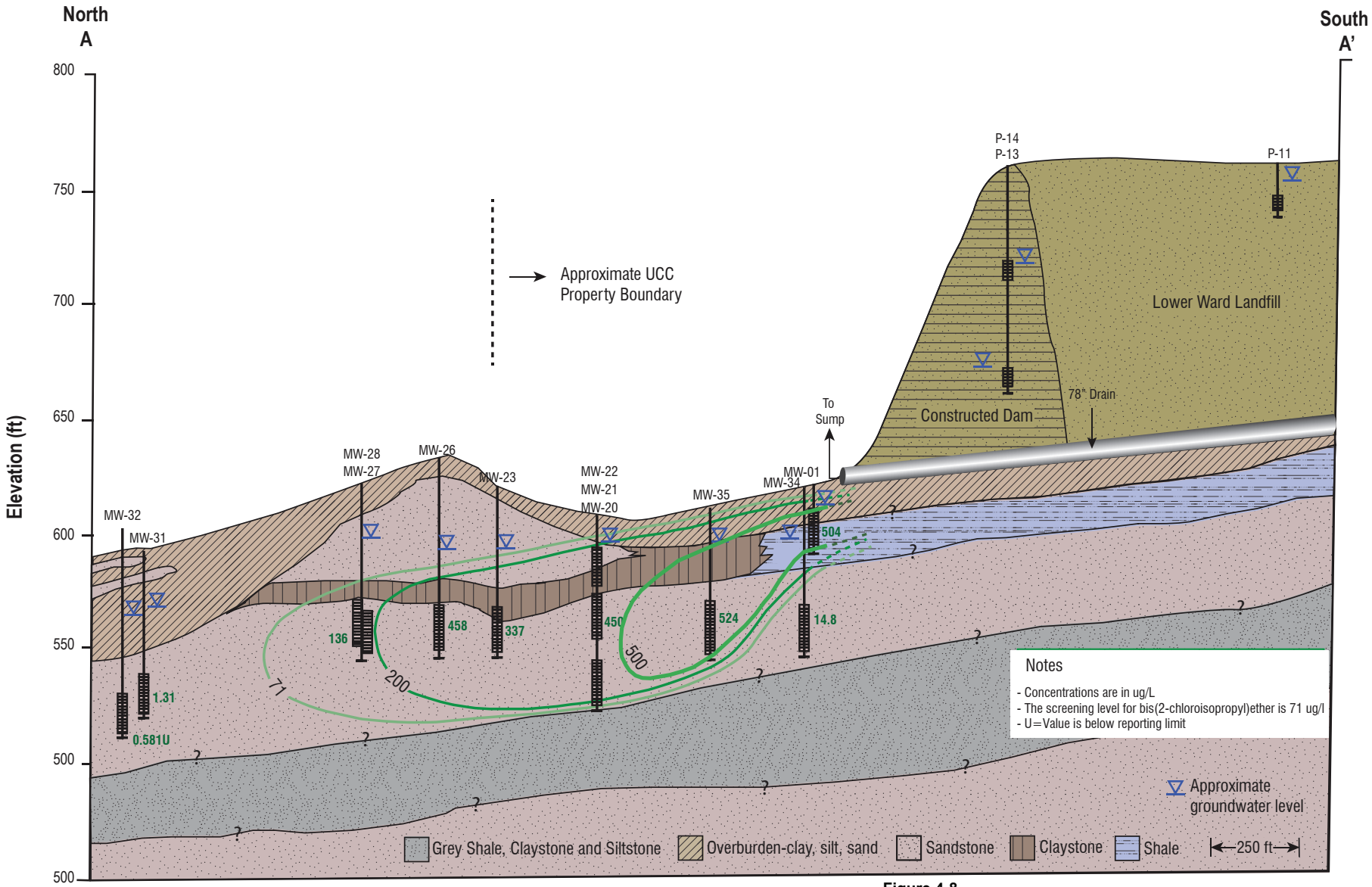


Figure 4-8
December 2016 Bis(2-chloroisopropyl)ether Vertical Extent Map
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

Analyte	Screening Level (µg/L)	Screening Level Source
cis-1,2-Dichloroethene	70	MCL
Tetrachloroethene	5	MCL
Trichloroethene	5	MCL
Chloroform	80	MCL

WVU-MW04	µg/L
cis-1,2-Dichloroethene	1.39
Tetrachloroethene	21.3
Trichloroethene	2.55
Chloroform	1.23

MW-104A	µg/L
Tetrachloroethene	2.6
cis-1,2-Dichloroethene	1.79

WVU-MW01
NS

WVU-MW02
NS

MW-33
NS

WVU-MW03
NS

WVU-MW05
NS

WVU-MW06
NS

Legend
- Monitoring Well
- Ground Surface Elevation Contour (10 ft interval)
- Facility Boundary
- Paved Surface
- Building
- Surface Water

Notes:
1. Result in red exceed screening level.
2. NS = Not sampled.
3. µg/l = Micrograms per Liter.
4. MCL = Maximum contaminant level.

N

0 200 400
Feet

Figure 4-9
December 2016 Greenhouse Area Groundwater Detections and Exceedances
2016 Groundwater Monitoring Report
UCC Technology Park
South Charleston, West Virginia

ch2m

\\LAKEFRONT\PROJ\GIS\DOW\TECHCENTER\REPORTS\2017\GWREPORT2016\MAPS\REPORT\FIGURE 04-09 - GREENHOUSE AREA GROUNDWATER DETECTIONS AND EXCEEDANCES.MXD JHANSEN1 3/10/2017 8:34:22 AM

Appendix A
Laboratory Analytical Data Reports and Data Quality Evaluation Report

Appendix B
Mann-Kendall Results for Plume Stability
(Summary Tables and Trend Graphs)

Table B-1. Nonparametric (Mann-Kendall) Trend Analysis for 1,4-Dioxane, Individual Monitoring Wells and Leachate Collection System

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
BW-02	3	22	25	12	0.257	3.06	0.522	0.257	NA	>50% ND	NA
MW-01	29	0	29	100	100	347	199	205	94.2% (+)	**No Trend**	**Stable**
MW-23	29	0	29	100	98.4	393	227	218	67.4% (-)	**No Trend**	**Stable**
MW-26	29	0	29	100	141	318	226	220	80.1% (-)	**No Trend**	**Stable**
MW-28	29	0	29	100	100	364	194	188	69.4% (+)	**No Trend**	**Stable**
MW-31	16	12	28	57	0.257	16.4	4.10	2.88	100.0% (sig +)	**Increasing Trend**	NA
MW-32	0	29	29	0	0.257	0.257	0.257	0.257	NA	>50% ND	NA
Leachate Collection System	13	0	13	100	107	211	152	144	86.0% (+)	**No Trend**	**Stable**

Notes:

mg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set.

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one.

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent.
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one.

(-) = negative trend

(+) = positive trend

Table B-2. Nonparametric (Mann-Kendall) Trend Analysis for Bis (2-chloroisopropyl)ether, Individual Monitoring Wells and Leachate Collection System

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
BW-02	3	20	23	13	0.080	1.23	0.325	0.257	NA	>50% ND	NA
MW-01	30	0	30	100	143	796	412	396	100.0% (sig +)	**Increasing Trend**	NA
MW-23	30	0	30	100	54.3	508	238	204	99.9% (sig +)	**Increasing Trend**	NA
MW-26	30	0	30	100	181	674	403	417	92.6% (+)	**No Trend**	**Stable**
MW-28	30	0	30	100	56.9	281	138	129	82.3% (+)	**No Trend**	**Stable**
MW-31	2	25	27	7	0.257	1.31	0.315	0.257	NA	>50% ND	NA
MW-32	4	23	27	15	0.257	1.55	0.378	0.257	NA	>50% ND	NA
Leachate Collection System	12	0	12	100	390	1,350	811	732	84.5% (-)	**No Trend**	**Stable**

Notes:

mg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(+) = positive trend

(-) = negative trend

Table B-3. Nonparametric (Mann-Kendall) Trend Analysis for Benzene, Individual Monitoring Wells and Leachate Collection System

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
BW-02	4	22	26	15	0.257	13.9	1.25	0.257	NA	>50% ND	NA
MW-01	29	0	29	100	9.66	33.8	24.8	25.2	100.0% (sig +)	**Increasing Trend**	NA
MW-23	28	1	29	97	0.257	9.29	4.41	4.32	99.4% (sig +)	**Increasing Trend**	NA
MW-26	29	0	29	100	6.60	20.2	15.6	16.4	100.0% (sig +)	**Increasing Trend**	NA
MW-28	26	3	29	90	0.257	7.41	2.69	2.57	99.5% (sig +)	**Increasing Trend**	NA
MW-31	6	23	29	21	0.257	4.46	0.779	0.257	NA	>50% ND	NA
MW-32	4	25	29	14	0.257	14.4	0.940	0.257	NA	>50% ND	NA
Leachate Collection System	13	0	13	100	35.2	66.7	45.5	43.3	91.8% (-)	**No Trend**	**Stable**

Notes:

mg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(+) = positive trend

(-) = negative trend

Table B-4. Nonparametric (Mann-Kendall) Trend Analysis for Barium, Individual Monitoring Wells and Leachate Collection System

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
BW-02	20	1	21	95	0.005	0.678	0.125	0.067	53.6% (-)	**No Trend**	**Not Stable**
MW-01	25	0	25	100	39.8	61.3	54.6	55.5	78.0% (-)	**No Trend**	**Stable**
MW-23	28	0	28	100	25.0	51.7	36.1	35.2	100.0% (sig +)	**Increasing Trend**	NA
MW-26	28	0	28	100	43.7	61.5	55.6	56.3	77.4% (+)	**No Trend**	**Stable**
MW-28	28	0	28	100	12.7	37.9	31.5	33.2	100.0% (sig +)	**Increasing Trend**	NA
MW-31	25	0	25	100	0.146	2.00	0.597	0.435	99.8% (sig +)	**Increasing Trend**	NA
MW-32	25	0	25	100	0.065	0.603	0.173	0.172	99.7% (sig +)	**Increasing Trend**	NA
Leachate Collection System	11	0	11	100	4.33	5.78	4.82	4.78	82.1% (-)	**No Trend**	**Stable**

Notes:

mg/L = milligrams per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

(+) = positive trend

Table B-5. Nonparametric (Mann-Kendall) Trend Analysis for Tetrachloroethene, Individual Monitoring Wells

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW104A	11	5	16	69	0.257	13.8	3.00	2.09	70.5% (+)	No Trend	Not Stable
WVU-MW04	16	0	16	100	7.12	58.7	32.8	30.9	87.0% (-)	No Trend	Stable

Notes:

mg/L = micrograms per liter.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

(+) = positive trend

Table B-6. Nonparametric (Mann-Kendall) Trend Analysis for Trichloroethene, Individual Monitoring Wells

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW104A	0	16	16	0	0.257	0.257	0.257	0.257	NA	>50% ND	NA
WVU-MW04	16	0	16	100	1.36	7.01	3.94	3.66	97.4% (sig -)	**Decreasing Trend**	NA

Notes:

mg/L = micrograms per liter.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

Table B-7. Post-2011 Nonparametric (Mann-Kendall) Trend Analysis for 1,4-Dioxane, Individual Monitoring Wells and Leachate Collection System

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
BW-02	1	13	14	7	0.257	3.06	0.457	0.257	NA	>50% ND	NA
MW-01	15	0	15	100	128	285	213	213	73.6% (+)	**No Trend**	**Stable**
MW-23	15	0	15	100	126	393	229	218	65.1% (+)	**No Trend**	**Stable**
MW-26	15	0	15	100	141	291	221	220	66.9% (-)	**No Trend**	**Stable**
MW-28	15	0	15	100	134	364	203	200	59.6% (+)	**No Trend**	**Stable**
MW-31	13	2	15	87	0.257	15.0	5.78	5.33	100.0% (sig +)	**Increasing Trend**	NA
MW-32	0	15	15	0	0.257	0.257	0.257	0.257	NA	>50% ND	NA
Leachate Collection	11	0	11	100	108	211	154	144	84.0% (+)	**No Trend**	**Stable**

Notes:

mg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

(+) = positive trend

Table B-8. Post-2011 Nonparametric (Mann-Kendall) Trend Analysis for Bis (2-chloroisopropyl)ether, Individual Monitoring Wells and Leachate Collection System

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
BW-02	3	11	14	21	0.080	1.23	0.369	0.257	NA	>50% ND	NA
MW-01	15	0	15	100	319	796	526	539	50.0% (+)	**No Trend**	**Stable**
MW-23	15	0	15	100	144	508	303	304	82.3% (+)	**No Trend**	**Stable**
MW-26	15	0	15	100	286	674	446	431	98.8% (sig -)	**Decreasing Trend**	NA
MW-28	15	0	15	100	88.9	281	153	120	79.6% (+)	**No Trend**	**Stable**
MW-31	2	13	15	13	0.257	1.31	0.362	0.257	NA	>50% ND	NA
MW-32	4	11	15	27	0.257	1.55	0.474	0.257	NA	>50% ND	NA
Leachate Collection System	11	0	11	100	390	1,350	838	746	95.7% (sig -)	**Decreasing Trend**	NA

Notes:

mg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(+) = positive trend

(-) = negative trend

Table B-9. Post-2011 Nonparametric (Mann-Kendall) Trend Analysis for Benzene, Individual Monitoring Wells and Leachate Collection System

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
BW-02	1	13	14	7	0.257	1.03	0.312	0.257	NA	>50% ND	NA
MW-01	15	0	15	100	25.1	33.8	29.0	28.8	89.9% (+)	**No Trend**	**Stable**
MW-23	15	0	15	100	2.56	9.29	5.64	5.70	75.2% (+)	**No Trend**	**Stable**
MW-26	15	0	15	100	15.9	20.2	18.1	17.9	59.6% (+)	**No Trend**	**Stable**
MW-28	15	0	15	100	2.34	7.41	3.33	3.18	85.9% (-)	**No Trend**	**Stable**
MW-31	2	13	15	13	0.257	4.46	0.613	0.257	NA	>50% ND	NA
MW-32	3	12	15	20	0.257	14.4	1.52	0.257	NA	>50% ND	NA
Leachate Collection System	11	0	11	100	35.2	66.7	45.7	43.3	98.0% (sig -)	**Decreasing Trend**	NA

Notes:

mg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(+) = positive trend

(-) = negative trend

Table B-10. Post-2011 Nonparametric (Mann-Kendall) Trend Analysis for Barium, Individual Monitoring Wells and Leachate Collection System for Data

2016 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
BW-02	14	0	14	100	0.022	0.111	0.059	0.065	96.9% (sig +)	Increasing Trend	NA
MW-01	15	0	15	100	48.8	61.3	55.2	55.5	96.7% (sig -)	Decreasing Trend	NA
MW-23	15	0	15	100	32.2	51.7	40.8	40.6	99.7% (sig +)	Increasing Trend	NA
MW-26	15	0	15	100	47.6	61.5	56.8	56.7	66.9% (-)	No Trend	Stable
MW-28	15	0	15	100	31.4	37.9	34.9	35.1	51.9% (-)	No Trend	Stable
MW-31	15	0	15	100	0.193	2.00	0.740	0.672	100.0% (sig +)	Increasing Trend	NA
MW-32	15	0	15	100	0.145	0.211	0.179	0.178	85.9% (+)	No Trend	Stable
Leachate Collection System	11	0	11	100	4.33	5.78	4.82	4.78	82.1% (-)	No Trend	Stable

Notes:

mg/L = milligrams per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

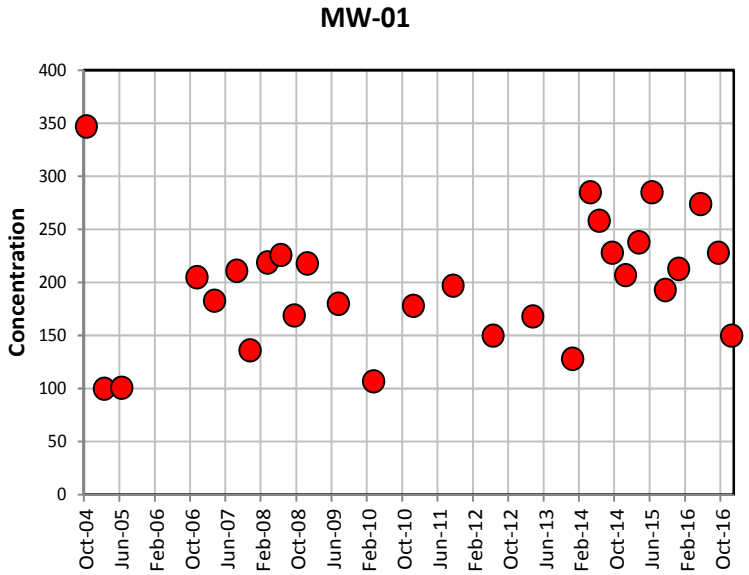
Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

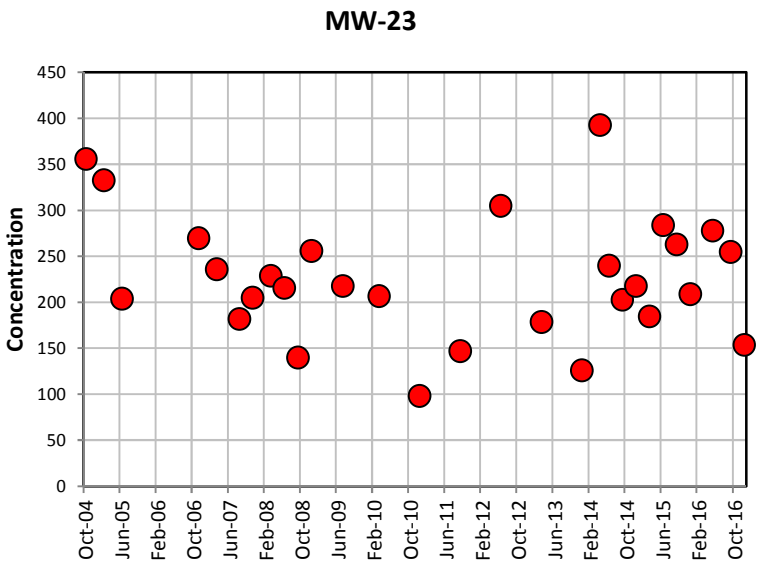
For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

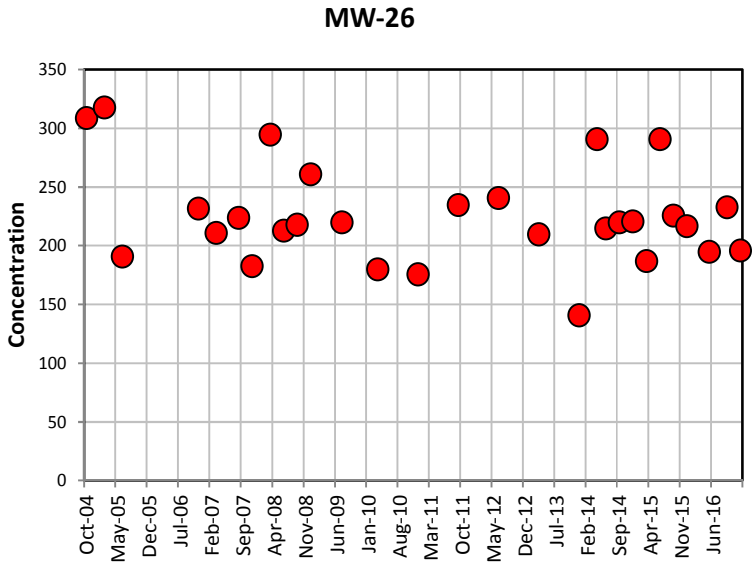
(+) = positive trend

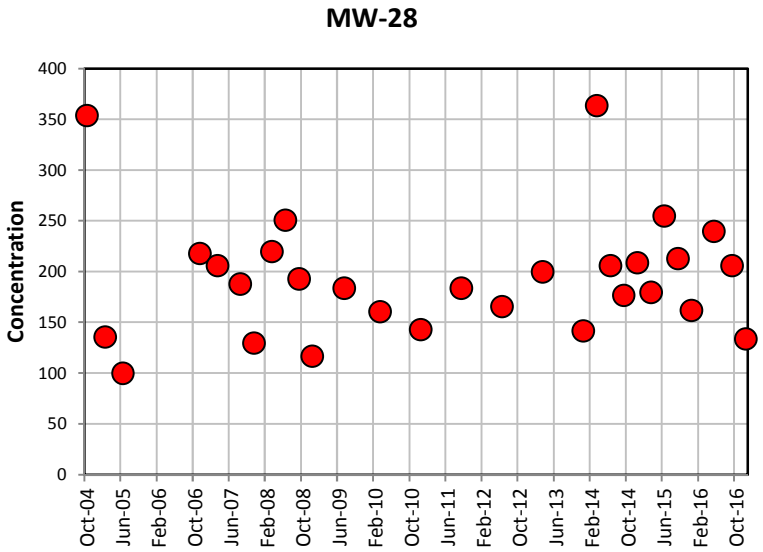




Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

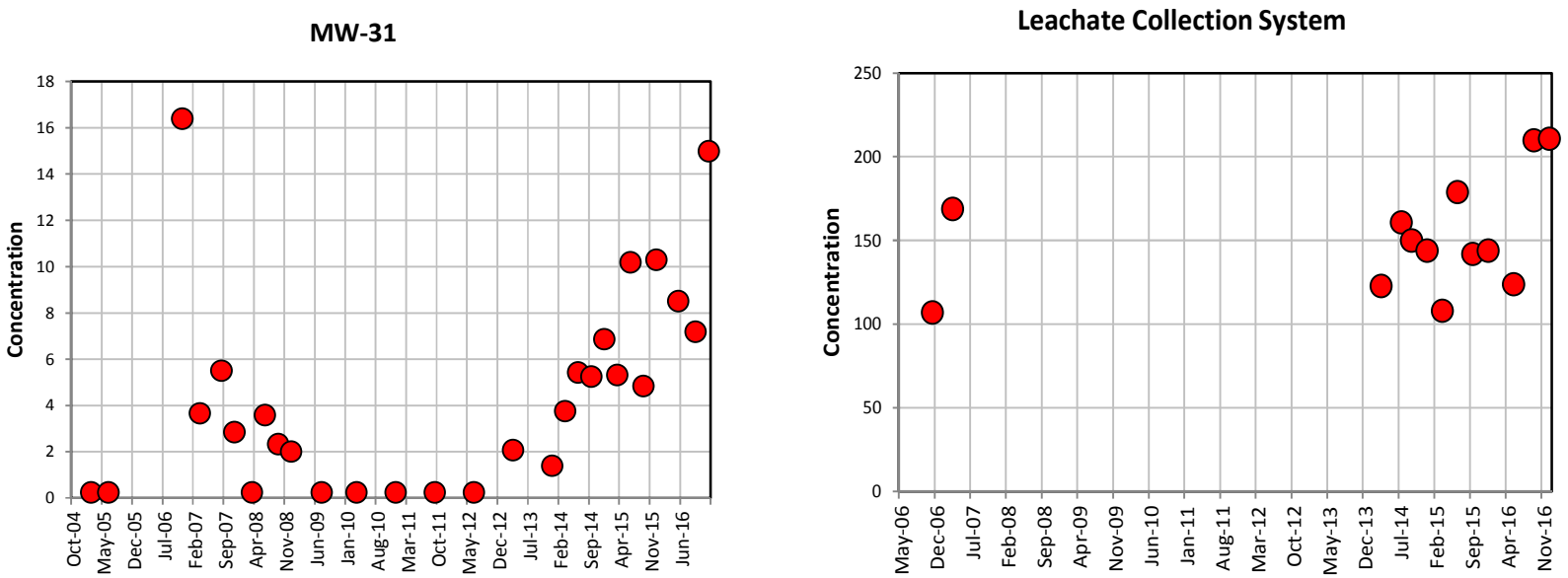
Figure B-1. Temporal Concentrations of 1,4-Dioxane in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia





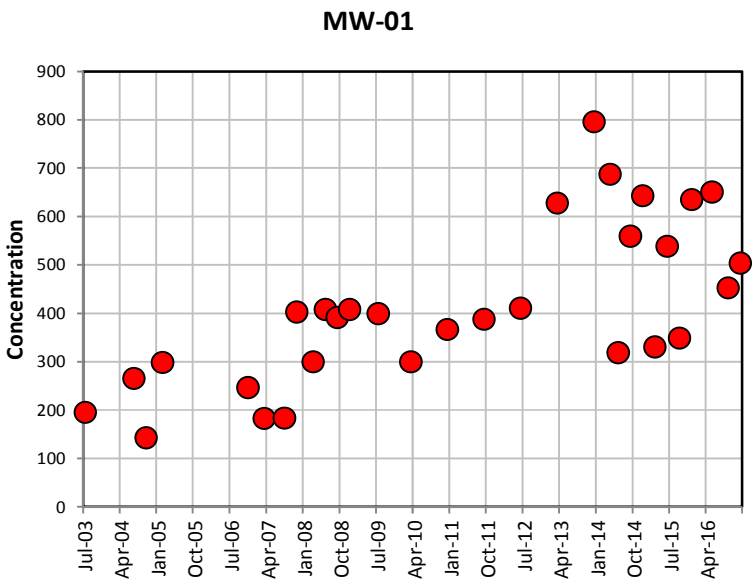
Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

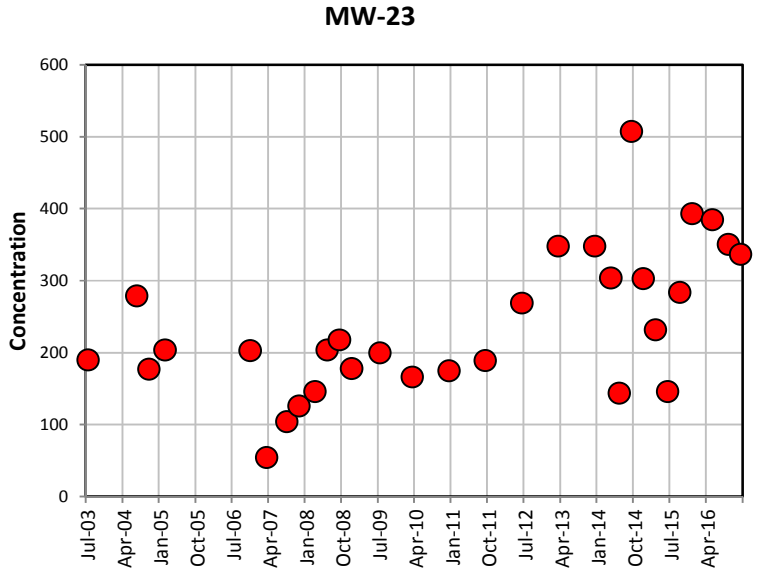
Figure B-1. Temporal Concentrations of 1,4-Dioxane in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia



Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

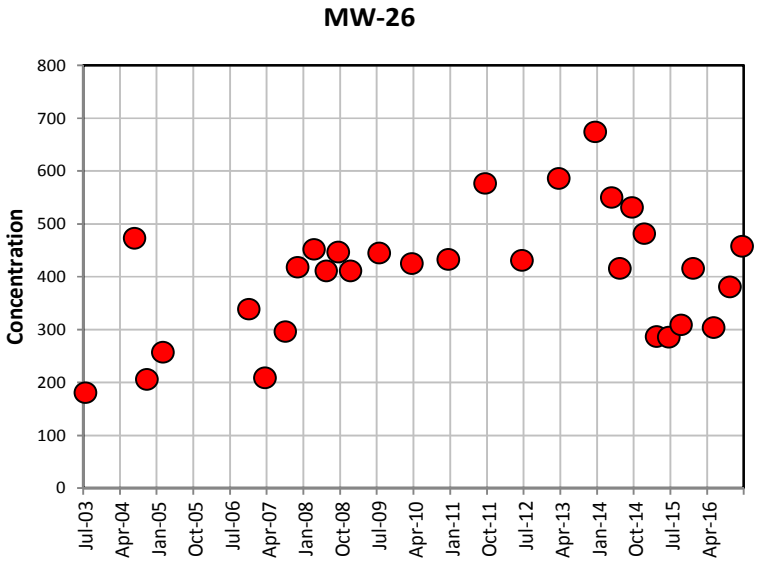
Figure B-1. Temporal Concentrations of 1,4-Dioxane in Select Monitoring Wells and Leachate Collection System
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

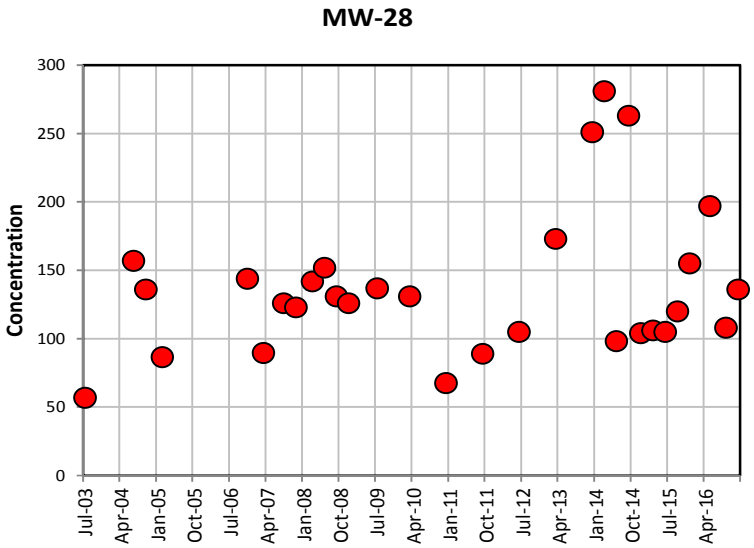




Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

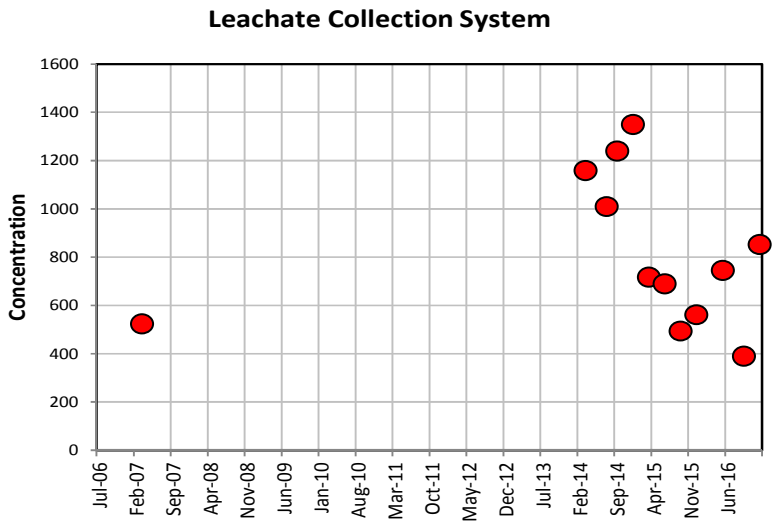
Figure B-2. Temporal Concentrations of Bis (2-chloroisopropyl)ether in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia





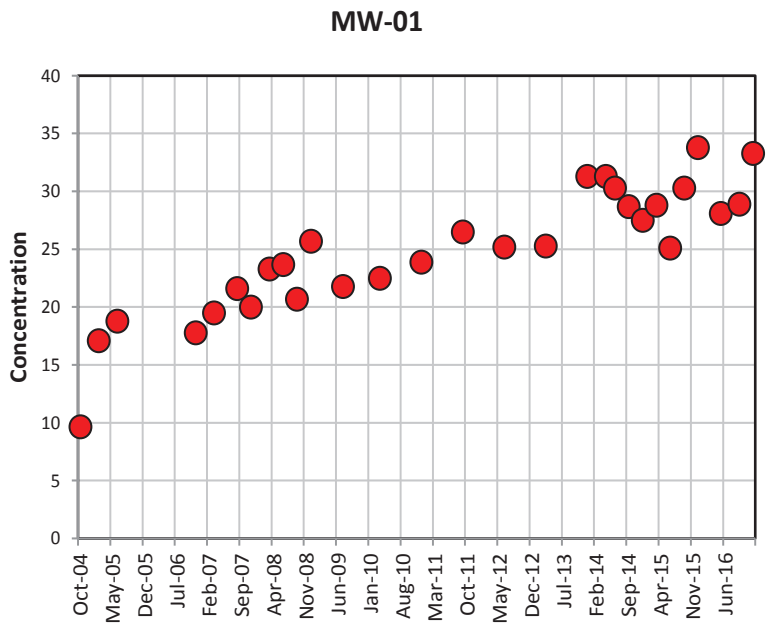
Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

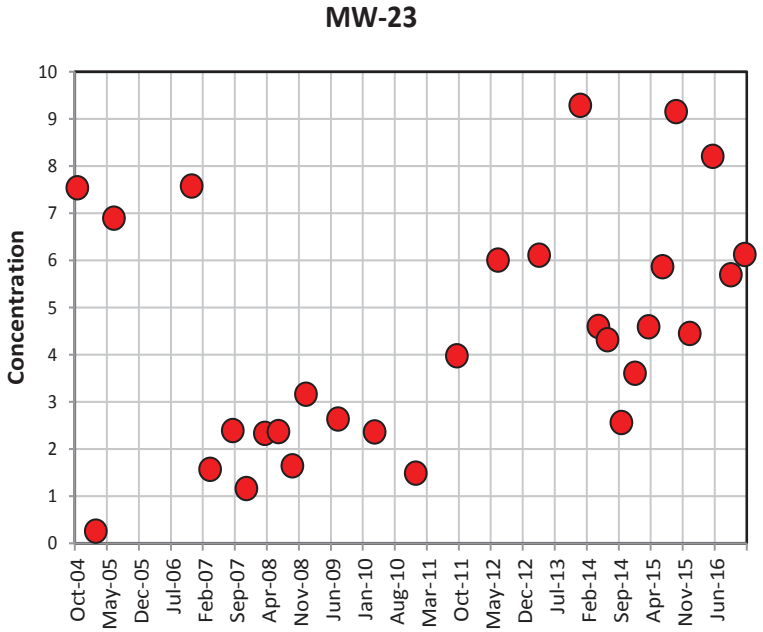
Figure B-2. Temporal Concentrations of Bis (2-chloroisopropyl)ether in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia



Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

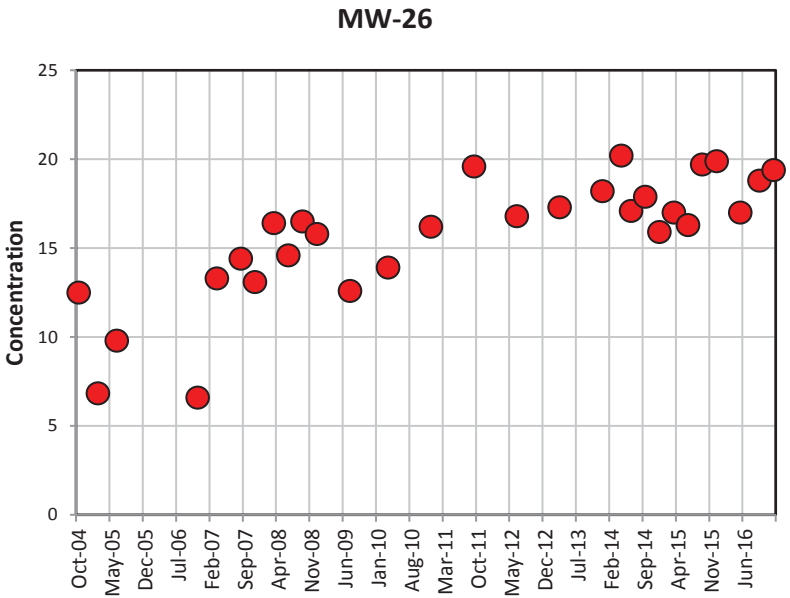
Figure B-2. Temporal Concentrations of Bis (2-chloroisopropyl)ether in Leachate Collection System
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

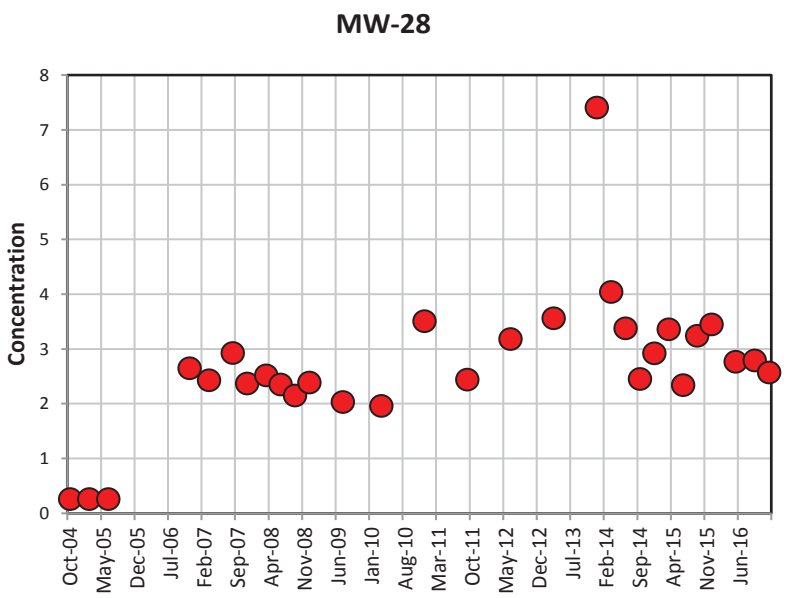




Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

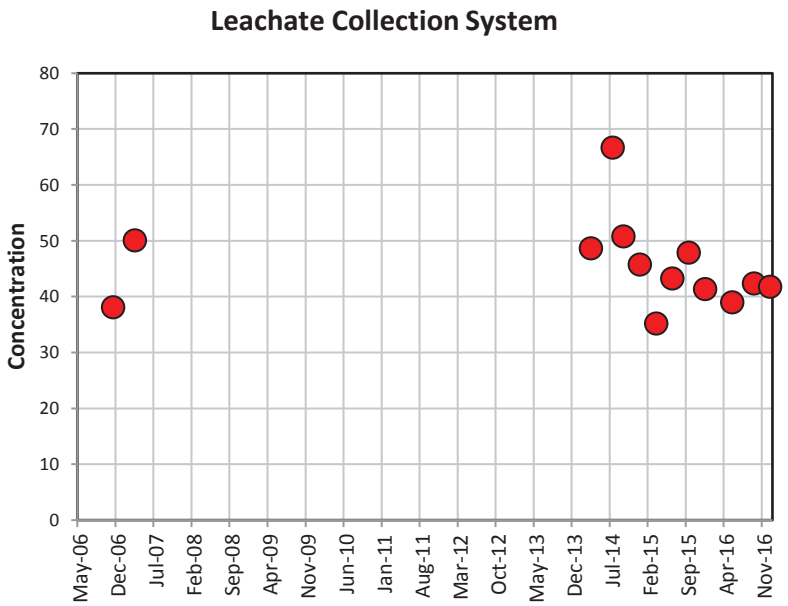
Figure B-3. Temporal Concentrations of Benzene in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia





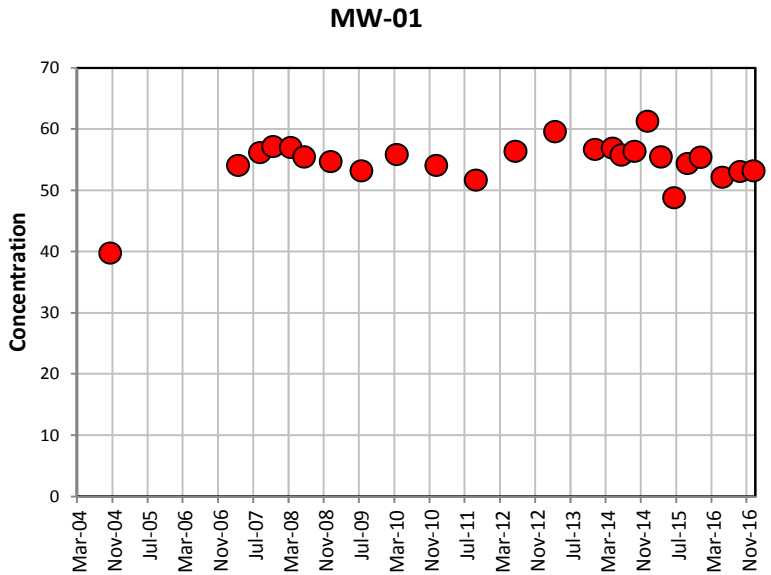
Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

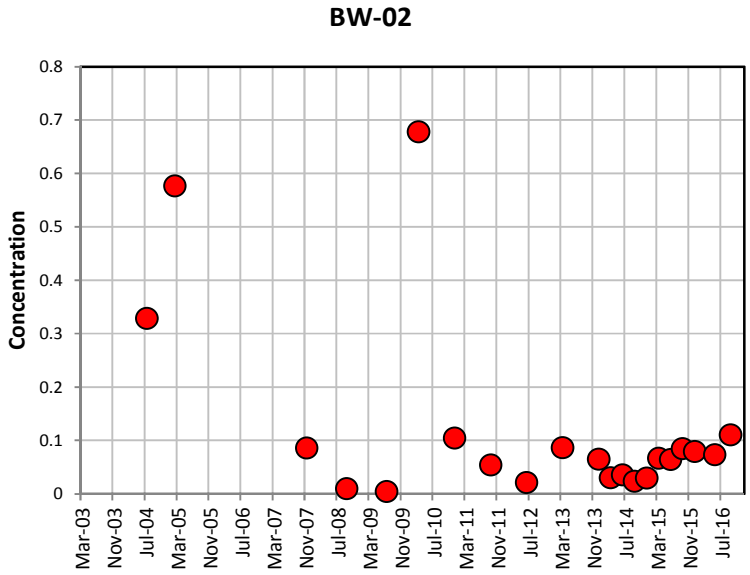
Figure B-3. Temporal Concentrations of Benzene in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia



Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

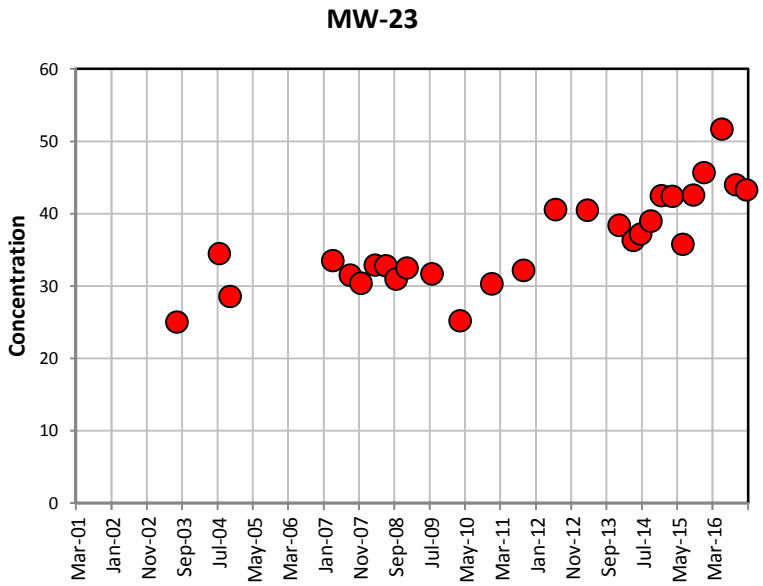
Figure B-3. Temporal Concentrations of Benzene in Leachate Collection System
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

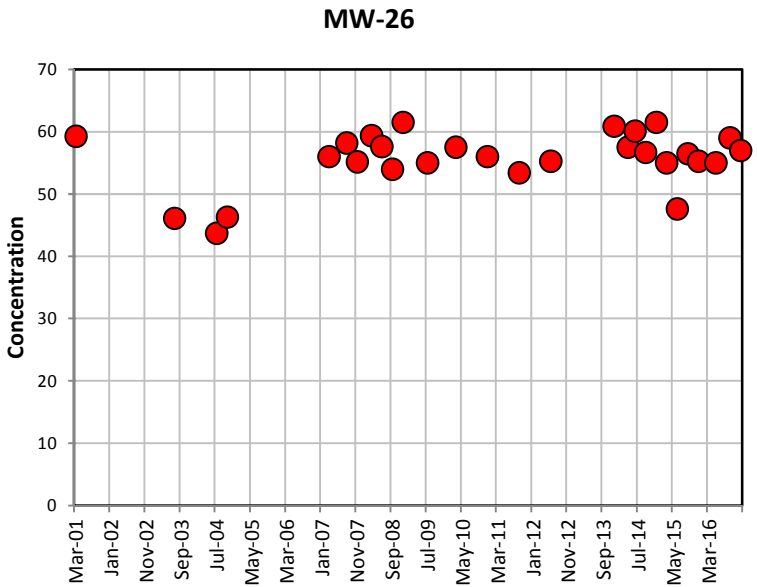




Note:
All concentrations in milligrams per liter (mg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

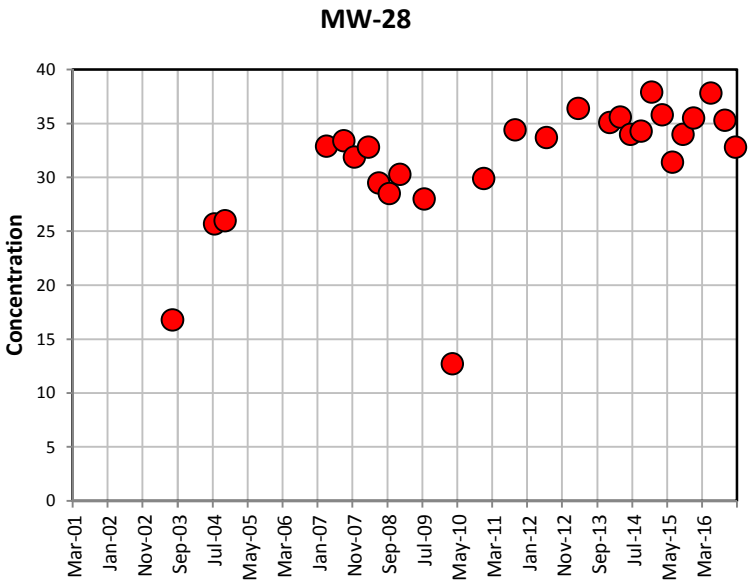
Figure B-4. Temporal Concentrations of Barium in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

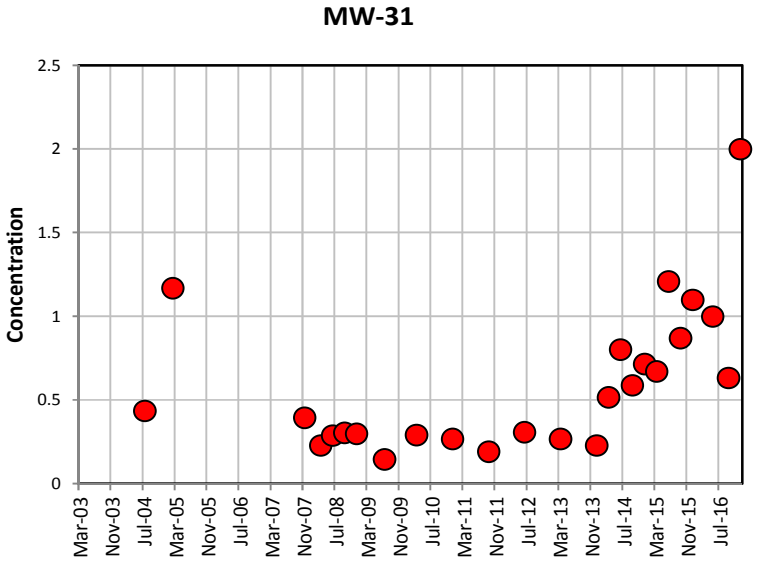




Note:
All concentrations in milligrams per liter (mg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

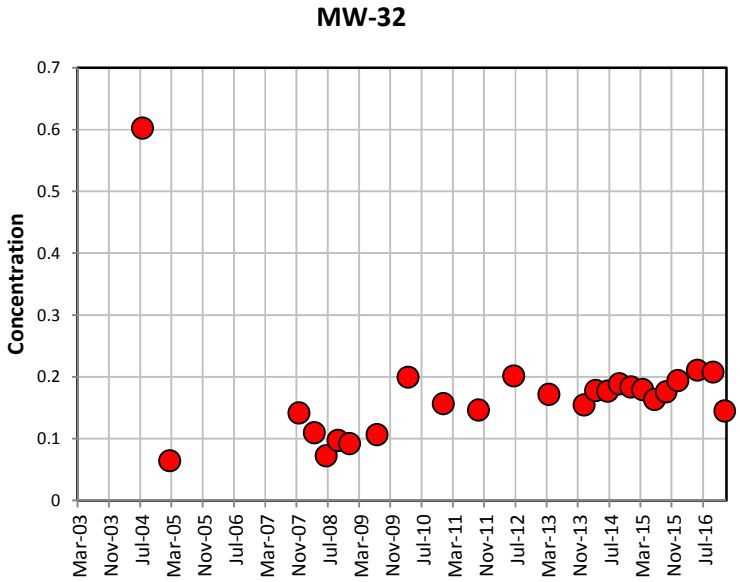
Figure B-4. Temporal Concentrations of Barium in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia

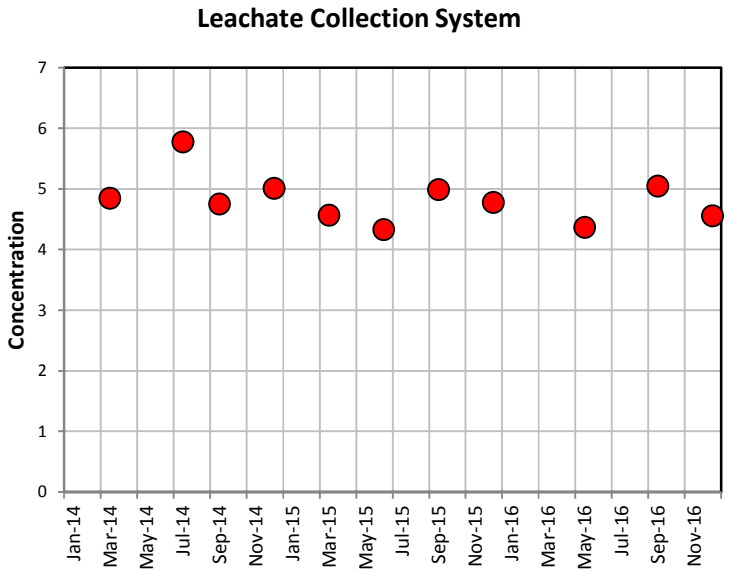




Note:
All concentrations in milligrams per liter (mg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

Figure B-4. Temporal Concentrations of Barium in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia





Note:

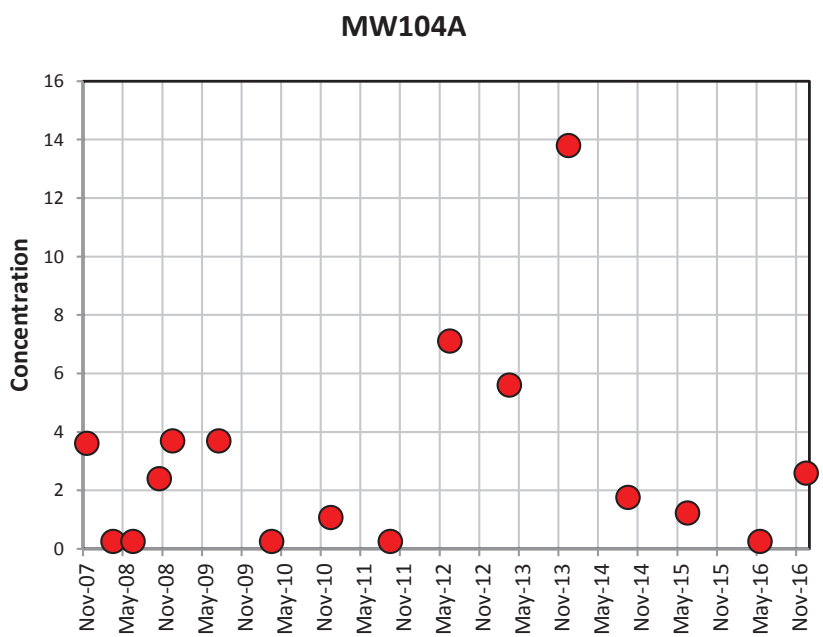
All concentrations in milligrams per liter (mg/L)

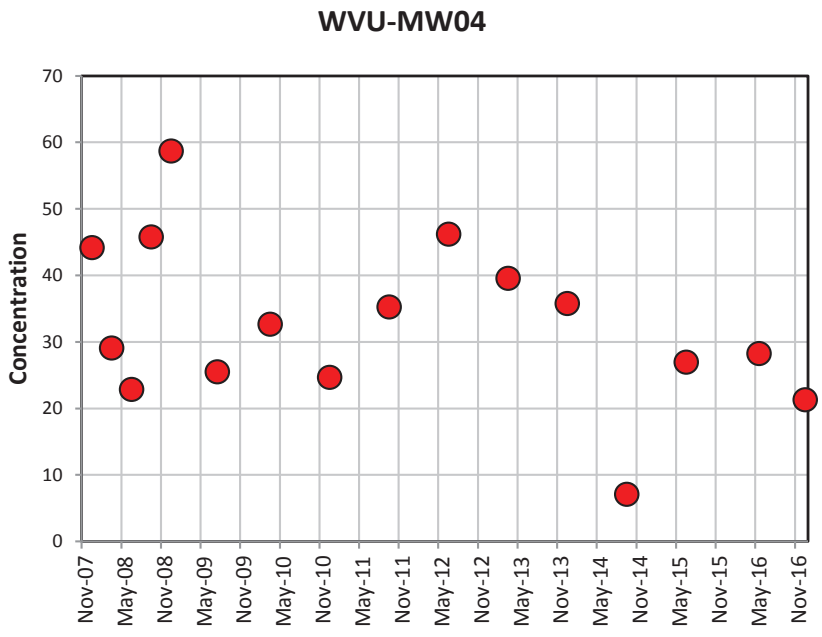
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

Figure B-4. Temporal Concentrations of Barium in Select Monitoring Wells and Leachate Collection System

2016 Groundwater Monitoring Report

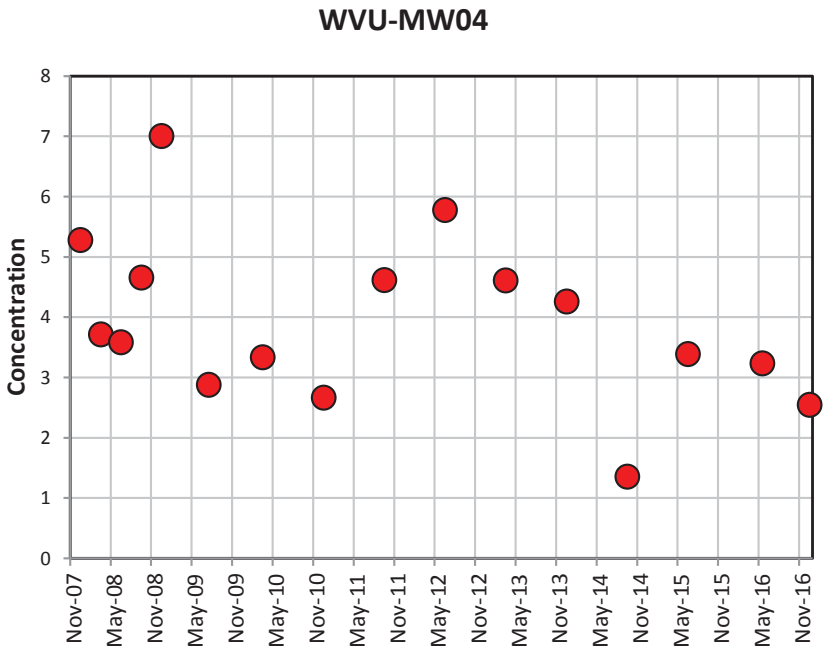
UCC Technology Park, South Charleston, West Virginia





Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

Figure B-5. Temporal Concentrations of Tetrachloroethene in Select Monitoring Wells
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia



Note:
All concentrations in micrograms per liter (µg/L)
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

Figure B-6. Temporal Concentrations of Trichloroethene in Select Monitoring Well
2016 Groundwater Monitoring Report
UCC Technology Park, South Charleston, West Virginia